Problems of the finishing room

Walter Karl Schmidt

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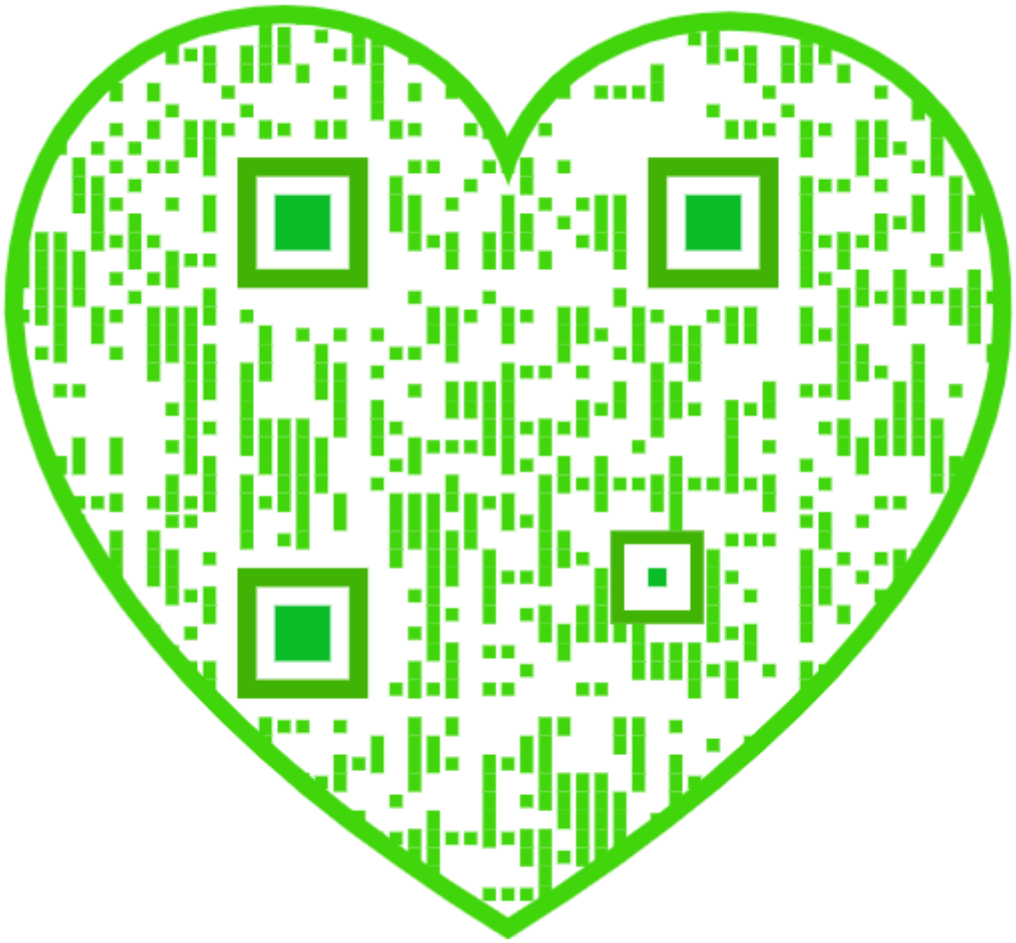

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PROBLEMS OF THE FINISHING ROOM

A Reference and Formula Manual for Furniture Finishers, Woodworkers Builders, Interior Decorators, Manual Training Departments, Etc.

BY
WALTER K. SCHMIDT

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AUTHOR'S NOTE.

In publishing PROBLEMS OF THE FINISHING ROOM it is the desire to give practical, detailed information of methods for the production and application of stains, fillers, shellacs, varnishes, and waxes, recognizing that latter day science has made it possible to produce better, more pleasing finishes by the elimination of certain dry colors, through the introduction of the ever increasing, fast-to-light aniline dye stuffs, and through the better understanding of the artisan in the production of chemical solutions which make use of the natural color-giving constituents ever-present in woods.

The formulas which are offered have all passed their experimental stage. The methods are practical, the results positive. In commending them to the wood finisher, confidence is expressed that many a difficulty will have been overcome for him.

Inasmuch as business conditions, and particularly those relating to all branches of chemistry and allied arts, are unsettled and unstable owing to the European war, it should be understood by the reader and the artisan that all prices quoted in this volume are such as would likely prevail in normal times.

While the author has gone much into detail in the following pages, he calls attention to the constantly increasing number of stain and finishing possibilities that are coming out from time to time. The reader is commended to the pages of the *Furniture Manufacturer and Artisan* in future numbers for many notes and formulas which may be incorporated in the blank pages in this book, by means of which he can keep up to the minute in finishing problems.

WALTER K. SCHMIDT.

Grand Rapids, Mich., June 1, 1916.

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CHAPTER I.

PLANNING THE FINISHING ROOM

TOO often in the planning of the furniture, piano or other woodworking factory scant attention is given to the finishing room. Just why this is, is difficult to conceive because this department is one of the most important in the whole factory. The cost of finishing is no inconsiderable item in the cost of production, and as the reputation of the goods produced depends upon the finish as much, or more, than upon any other single item, there is every reason why this department should receive every attention necessary to raise its efficiency to the highest point of perfection.

BUT SCANT ATTENTION PAID TO FINISHING ROOM.

In the factories of more than one story, the finishing room is usually located at the top. This is done as a matter of convenience in the handling of stock as well as to have it as far as practicable from the dust of the woodworking departments. While the top story has many advantages over any other part of the factory for the location of the finishing room, it has a few disadvantages, and provision should be made to counteract them.

In the first place the whole accumulation of gases of the various departments below the finishing room will rise and ultimately reach the top story. This fact, together with the fact that all the materials used in finishing generate a considerable quantity of gas, extra provisions should be made for carrying it away. In making this provision, we find the top story possesses advantages not to be found in other flats. Ventilators may be put in the roof at regular intervals, the number of these ventilators to depend on their capacity and the amount of gas to be carried away. There are many forms of ventilators in use, and it is not for us to discuss the merits of any particular kind, the chief consideration being that they are large enough to carry off the gas and be easily regulated.

But while we are considering the gases and vapors

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that may arise from the floors below, we must not overlook the fact that many of those given off by the finishing process follow the floor; in fact, they seek the lowest level. Thus naphtha, benzole and kindred hydrocarbon compounds, in their process of evaporation, produce gaseous compounds that are heavier than air and consequently sink to the lowest level. This is contrary to the general understanding of gases, a fact to be reckoned with. For instance, naphtha used in large quantities is dangerous because in a case where the boiler room may be in the basement the fumes or gases may follow the floor down the elevator shaft with dangerous results.

WHERE BEST TO LOCATE WORKROOM.

The ventilating system therefore would have to be arranged to provide ceiling and floor exhaust, so that the floor of the finishing room would have an outward exhaust.

This is an essential provision where goods are dipped in so-called oil stains. The ventilating proposition has its direct bearing upon the insurance rate, as insurance companies are mindful of the dangers arising from the gases evolved by the drying processes of a finishing room.

The finishing room of the future will be a place of rapid processes. Instead of having to wait days between the various processes it will be only a matter of hours; and instead of it requiring weeks to complete the whole process the thing will be accomplished in a few days at the most. Already in the varnish room the number of days required has been reduced to as many hours. Just what this means in dollars and cents to the manufacturer of finished articles, each one can best figure out for himself; but it means a big thing in rush seasons when time is limited. It is important that in planning the finishing room and its equipment consideration be given to the claims of the modern varnish drying room.

FINISHING ROOM OF THE FUTURE.

In laying out the finishing room and locating the various processes, it is important to have the stock follow from one process to the other with as little moving as possible. In a factory with only one elevator the ideal finishing room is one in which the stock

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is unloaded from the elevators into the staining and filling department; and when this process is finished, the stock is moved toward the shellacing department, then on to the sanding and varnishing departments. Both the varnish and the rubbing rooms should be in close proximity to the stock room so that the goods, when varnished, may pass immediately into the rubbing room. This brings the goods back into the elevator.

PROPER LOCATION OF DEPARTMENT.

If the dipping process is used in staining, filling or varnishing, the space required for these operations should be partitioned off from the other departments. This should be done in the interest of those not engaged in dipping. The great amount of stain or varnish, suddenly spread out, generates a vast amount of nauseating gases and if the work is done in open shop, the whole room is affected. The very best ventilating system possible to devise should be installed in the dipping room to carry off these gases and not allow them to escape to the other departments. Of course, the gases generated and confined to the dipping room are equally as bad for the man there as for those in the other departments. But the fewer men affected the better.

A factory recently installed a system whereby the product is carried on trucks, especially built, from the first operation in the finishing department straight through the finishing room, for sanding, staining, filling, shellacing, waxing and varnishing. There was no useless handling; space was saved, time and labor lessened and better results were obtained.

HOW TO HEAT A FINISHING ROOM.

The question of heating the finishing room cannot receive too much attention. A fairly uniform temperature throughout the day and night is of great advantage in drying finishing materials. If anything like good work is to be done in the varnish room it is absolutely necessary that there shall be proper facilities for heating. This department is required much earlier in the fall and a little later in the spring than are usually some of the others. If a vacuum heating system is in use and exhaust steam is used for heating, a separate system should be installed for heating the varnish room.

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It requires considerable steam to run the pumps of a vacuum system and if an independent system is installed and live steam used, no pumps will be required. The average varnish room in this way can be heated with less steam than would be required to run the pumps of the vacuum system alone. This independent system need be used only when the vacuum system is not required throughout the whole factory.

QUESTION OF BEST SYSTEM.

The question of what kind of a heating system is best adapted for the finishing room need not be discussed at any length here. While the modern air system may be preferred for the other departments, there is too much danger of dust being conveyed into the varnish room for it to find favor with the finishers. Steam heating is pretty generally admitted to be the best suited for this department.

But the question whether to use radiators or rows of pipes, and whether to place them along the wall near the floor or overhead near the ceiling, is not so easily disposed of. Each has its advantages and disadvantages. If steam pipes are used and are placed overhead they are out of the way; but overhead pipes are hard on the workman. If it is quite necessary to locate the pipes overhead, they should be placed along the wall above the windows, and not immediately above the men's heads, as I have sometimes seen them. But it is much better to place them along the wall near the floor. A better radiation may be obtained with the pipes there. More uniform temperature above and below, and more pleasant conditions for the workmen, are some of the chief advantages.

Radiators placed at regular distances along the wall will be found to be the most satisfactory way of heating. With these a much more uniform temperature may be obtained and maintained. With the steam pipes one must either have them all on or all off. The usual way of regulating the temperature is: When the temperature is a little too low, turn on the steam; when it gets a little too warm, turn it off. But with the radiators, the actual number required to keep the correct temperature may be kept in use throughout the day. A thermostat will settle the question. They are

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not expensive and adjust the temperature automatically. They stop all argument between the workmen if one wants it hot and the other cool. It establishes a de facto temperature and all arguments cease.

Light, and plenty of it, is essential to the finishing room. But light is not everything. The quality of light is as important as the quantity. Some factories are making the serious mistake of putting corrugated glass in their windows, the light from which has a depressing effect upon the workmen, and the absolute seclusion which it provides makes factory life just a little more like prison life than is either necessary, or in the interest of employes or employer. Under such condition the best results are not possible.

MUCH LIGHT ESSENTIAL TO FINISHER.

Man is made with a long range of vision, reaching away off to the horizon. It is true that the vision is adjustable and may be focused on objects near or far. It is this focusing, or continual changing of vision from long to short range that is necessary during outdoor life, which is so restful to the eye and keeps it in good condition. It is only when we attempt a continual restriction of the range of vision that trouble with the eyes begins. Many men are performing their duties in a perfunctory way, but moving around listlessly with weary eyes and aching head as a result of this restricted vision. It is not necessary that the man stand and look out the windows to get relief. If the eye, even for a moment, can reach out beyond the hard stone walls to the distant hills, even though the man be not aware of it, it has a soothing and restful effect.

WHITEWASH UNDESIRABLE IN FINISHING ROOM.

Do not whitewash the ceiling of the finishing room. It may save a few cents in insurance premiums, but in other ways it will cost as many dollars before one is through with it, especially if the varnish room ceiling is whitewashed. Some insurance companies urge this whitewashing upon manufacturers, but these people understand insurance much better than finishing. Some claim to have a formula for making whitewash that will not peel off. I have seen this formula used both with the brush and the spray pump and it peeled off. I have met a good many manufacturers who were induced to whitewash the ceilings of their varnishing

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rooms along with the other parts of the factory, but I have never met one such who did not repent it. Whitewash is different than paint. The liquid in paint is the binder. It is this binder that enters the pores of the wood, works itself around the fibers and takes a firm hold. It clings to both the pigment in the paint and the fibers of the wood and binds the two together.

CHIPPING OF WHITEWASH FLAKES HURTS FINISH.

Not so with whitewash. Water is the liquid here present and is used to liquify the whole so that it will be spread out. Or perhaps we should say that the water is the medium by which the whitewash is conveyed to the wood. Part of it penetrates the wood and part evaporates, but it has no binding qualities. The remaining substance in the whitewash, lime and other ingredients, is too heavy to penetrate far enough into the wood to get a firm hold. The constant changing temperature to which the ceiling of the upper story of every factory is subjected results in the extremes of expansion and contraction, and the whitewash, being brittle when dry, cracks and as its hold on the wood is not very firm it falls off. Any finisher can tell you what this means to freshly varnished stock, and even to the stock that is dry.

If something must be done to the ceiling of the varnish room to render it more fireproof, put on an oil paint. If an inexpensive pigment is used the cost of this need not be high; but in any event the first and last cost will not be as high as the ultimate cost of whitewash.

Now and then someone raises the question of light in the finishing room and its effect upon the drying of finish. There are some finishers who will contend that light is just as essential as air to proper drying, and that varnish will dry faster in a well lighted room during daylight than it will at night. Others take a different view of this matter and insist that the drying out of varnish and other finishing materials is purely a matter of temperature and air circulation and that the light has nothing to do with it.

There is room for argument on this question, perhaps, but there are other points about light in the finishing room well enough established to require but

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little argument. One of these is that good daylight is essential in staining if one would maintain uniformity in stain shades, or stain with any degree of exactness whatever shade is wanted.

The ideal light for this kind of work is the same as the ideal light for the artist—light coming from the north side so that it will remain practically uniform and not vary materially with the passing of the sun as when the light is received from any of the other three sides. Another thing we know is that sunlight shining directly on either unfinished or finished woodwork has a tendency to bleach out and deaden colors. Therefore the direct rays of the sun should be avoided if one would get and keep the right kind of live color tone in finished work.

DIRECT RAYS OF SUN TO BE AVOIDED.

To keep finished work fresh, or even prepared woodwork before the finish is applied, it should be stored in a dark place, and especially protected from sunlight. From all this we may safely argue that light is an excellent thing in the finishing room, as it enables one to judge stain shades better, and also makes for greater skill and more satisfactory results in spreading varnish and other finishing coats. Also it will perhaps be accepted without argument that daylight is much better for this kind of work than artificial light. The electric light firms are making wonderful progress, however, in artificial light, and may soon be able to furnish something practically as good as daylight. They are not likely to furnish anything better.

So the ideal finishing room is one that is well lighted, that is well provided for receiving daylight, preferably from the north side. When it comes to drying, either in the finishing room, or in any specially provided drying room, some actual value of light will have to be demonstrated before it will receive much consideration, and the main factors to provide for are temperature, air, circulation and a conditioning of the air so that it will carry the same percentage of moisture all the time.

Every finishing room should be equipped with the facilities for heating water. The best way to do this is by the use of a vat with a steam coil in the bottom.

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Where water is to be used for dissolving stains it is not advisable to turn the steam into the water because of the possible danger from boiler compounds. Where chemical compounds are used the only safe way is the coil with the return pipe.

Where chemical compounds are not used, or the water is to be used for cleaning, heating, etc., the steam may be turned directly into the water. A good apparatus for thus heating water may be made by bringing the steam pipe into the finishing room at a point most convenient for heating the water. If the pipe enters through the floor proceed as follows: Place a valve for regulating the steam at a convenient height from the floor. Into the top end of the valve insert a pipe about a foot long. On the end of this pipe place an elbow, screwing it on tightly. Into the open end of this elbow insert another pipe about 10 inches long; screw this up tightly also. Place an elbow on the free end of this pipe, giving it a hold of six or eight threads. This elbow must not be tight. Insert into the open end of this elbow a pipe 15 or 20 inches long. The loose elbow on the end of this pipe will enable one to raise the pipe so that a pail of water may be placed beneath; then the end of the pipe is lowered into the water and the steam turned on. By this method a pail of water can be heated to the boiling point in a few seconds.

HOT WATER IN CONSTANT NEED.

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CHAPTER II.

SYSTEM FOR THE FINISHING ROOM.

THE foreman finisher of today, while he may not be confronted with so great a variety of colors, among them fumed oak, weathered oak, mahogany, etc., realizes the necessity for different interpretations of these colors. The conception which the various manufacturers have of one color necessitates the varying of these particular formulas so as to match the shade adopted by some other maker. It is, therefore, necessary that the foreman finisher be equipped with such apparatus as will enable him to do his matching in a methodical manner.

VALUE OF RECORDS OF MATCHINGS.

To establish a rule by which all of these matches may be made will be of great benefit to him if this course is pursued. He should keep a record of each matching, either in a book or, better, a little card index, carefully filed away, to correspond with the numbering given the different matchings. He should have, in addition, a board sample of the shade produced by the formula for matching the same number. When an order is received, accompanied by a sample board, he selects from his stock of samples the one matching most nearly the one received, turns to the corresponding formula and builds upon it or modifies it so as to match the sample received from his correspondent. This, again, is given a number and in a short period of time he has an archive of information which will not only give him record of the goods used, the percentages, etc., in each combination, but also should give him a complete record of the source from which he obtained the various constituents of each formula.

A good pair of scales, sensitive from a grain to two ounces, a mortar and pestle, graduates, stirring rods, a set of small brushes kept exclusively for this purpose, a complete set of board panels, showing the various flakes and grades of wood so that when a sample comes in made on a flaky piece of wood it can be

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matched on the piece of wood which corresponds to the sample, should be at hand. A set of colors made up of the primaries, the necessary chemicals which are used in the finishing room, such as bichromate of potash, caustic potash, the acids for setting the colors, is also necessary. Where oil stains are employed, the necessary solvents, such as benzole, acetone, wood alcohol, should be carried. There also should be a water bath, with some suitable porcelain-lined or granite ware dishes. It is not commonly known that oil soluble colors can be dissolved quickly in heated benzole, turpentine or oils and that a more uniform result is obtained by making the solution of these colors by the use of the water bath. It is taken for granted, of course, that this water bath will be steam heated.

EQUIPMENT OF FINISHING ROOM.

Unfortunately, we have in this country three kinds of weights, of which there is practically but one unit: The Troy weight, with its twelve ounces to the pound; the apothecaries' weight, with the same number of ounces to the pound but not the same number of grains, and the avoirdupois weight, with sixteen ounces to the pound. Now, while all these different weights have one practical unit, there is always present the possibility of errors getting into a formula through the interchanging of ounce weights, dram weights, and in multiplying a formula to a larger working quantity. The balance, or scale, shown in the accompanying cut as No. 8, therefore is preferable. There also should be a set of weights having 480 grains to the ounce. To avoid any possibility of misconception, before we go any farther, I suggest that the reader provide himself with any little pocket diary in which can be found the different weights used in the various kinds of weights. Let each one also establish for himself a rule for his formula.

THE QUESTION OF WEIGHTS.

Now, here you will have to follow me closely. We are going to use both dry and liquid measures. The smallest graduate that you may use will be a minnim graduate, and will be used only for very small amounts. A minnim is the equivalent of one drop of liquid, sixty of which make a dram. The next size graduate will be either an ounce or four ounces. Graduated in drams,

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i. e., if a one-ounce graduate, the markings should be in drams, eight drams making an ounce. If a four-ounce graduate, the markings should be for the first ounce in drams and the balance up to four ounces in quarter and half ounces. The next graduate should be either of pint or quart capacity, graduated from one to four ounces. With a set of graduates as described above, one is able to handle any problem that may arise.

LABORATORY EQUIPMENT.

Thus it will be seen that the minim graduate represents 1 drop, 60 minims 1 dram, 8 drams 1 ounce, 16 ounces 1 pint, 2 pints 1 quart, and 4 quarts 1 gallon. As this is the liquid measure which we employ, I recommend, to avoid confusion, a set of weights to use in weighing stains, etc., made up as follows:

	GRAIN WEIGHTS	
1, 2, 3, 5 and 10	20 grains	equal 1 scruple
	SCRUPLE WEIGHTS	
1 and 2	3 scruples	equal 1 dram
	DRAM WEIGHTS	
1, 2, 3 and 4	8 drams	equal 1 ounce
	OUNCE WEIGHTS	
½, 1, 2 and 4	16 ounces	equal 1 pound

MEASURING AND MIXING JUG

MINIM GRADUATE

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It will be seen that the foregoing is a conglomeration of the three different kinds of weights, but that it conforms with the liquid measure commonly used, inasmuch as it makes 16 ounces to the pound; it differs from the apothecaries' weight, and inasmuch as it uses 480 grains to the ounce it differs from the avoirdupois weight. In purchasing scales you will always find that they are accompanied with grain weights up to two drams. Above that they will have ounce weights. But these ounce weights have 437½ grains to the ounce. While this slight difference might not be noticed in some formulas, in others when formulas are multiplied to make a larger quantity, the discrepancy will absolutely change the shade of the stain which it is attempted to make. This is why I recommend a balance scale so that the weights desired can be placed on the opposite pan. It will take but a short time to familiarize oneself with these units, and when the units that establish the formula are used in the entire work, the multiple of a formula will be correct. Any of the readers who now have scales and wish to employ the above suggestions, can easily test out their scales by beginning with the grains and multiplying up until they have established a unit of 480 grains, then making comparison with their ounce weights when it will probably be found that these show but 437 grains. It should then be an easy matter to either weight these weights with more lead or to make some weights out of lead pipe and mark them. For example: 1 ounce, 480 grains.

VARIATION IN WEIGHTS.

A FUNNEL

The mortar and pestle is positively the handiest thing for thoroughly mixing and reducing to a fine powder the various colors and chemicals employed. For example, in making up a formula, I will say, of 20 grains of black, some orange and bichromate of potash, these chemicals can be weighed out, rubbed up finely in the mortar and half of the quantity of water added

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and thoroughly stirred. It will be found that nearly all of the color has been dissolved, but that there is sufficient color left in the bottom of the mortar which might change the color. Now you can readily see what it would do to a formula, the amount of which has been many times increased but not all dissolved. Therefore, after pouring off the first water, use a little more water to stir the balance of the color in the mortar and continue to add small portions of water until all of the color is dissolved. You will then be certain that all the color has been dissolved. In the cuts I have shown the handiest and most useful styles of graduates. As these graduates are used for either water, spirit or oily liquids, get the graduates made in the larger sizes which have a flat bottom with the markings on the outside. These are easily kept clean and clean dishes are absolutely necessary in the experimental work in the finishing room, as it takes but a small amount of color sometimes to ruin a formula.

A MORTAR AND PESTLE

HOW TO USE APPARATUS.

In some factories they make their own fillers, or rather, they color their own fillers, and in others they have ready-made fillers. Every finisher knows that a certain amount of his results depend upon the filler used. In matching up a piece of wood or establishing a formula, it is just as necessary to know what filler to use as it is to know the composition of or the stain used. The filler which is at hand may not be dark enough and, therefore, the compounder should have at his disposal the few colors ground in oil which are used in color filler, such as black, browns, rose pink and the siennas. Then in the changing of a filler, or the coloring of one, he can weigh out his colors, and thereafter have no trouble in producing the same shade of filler.

RESULTS DEPEND ON FILLER USED.

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Colors ground in oil can be weighed out just as easily as dry colors. For this initial work you can take two pieces of glass, evenly balanced, and put your paste color on this glass. Brush it clean with the liquid used in thinning the filler.

HOW TO USE CARD REFERENCE IN STAINING.

To further illustrate my idea of how a card reference should be made, let me introduce one here:

WATER STAIN EXPERIMENT CARD NO. 506
Match for I. C. PROGRESS & CO.'S Mahogany, on Birch, Water Stain.

Water	Scarlet	Black	Orange	Bichromate of Potash	Filler
1 Pint	1 dram 2 scruples	30 grs. 30 " 20 "	2 scruples 1 scruple	1 dram	Marietta's Standard Shade
Total in grains	100	80	60	60	
To make a gallon multiply by 8, there being 8 pints to the gallon	800	640	480	480	Reduce to the largest units
	1 oz. 5 drams 1 scruple	1 oz. 2 drams 2 scruples	1 oz.	1 oz.	

Thus, the formula for matching I. C. Progress & Co.'s mahogany on birch as given above and fully interpreted reads: To 1 gallon of water add 1 ounce, 5 drams, 1 scruple of scarlet; 1 ounce, 2 drams, 2 scruples of black; 1 ounce of orange, 1 ounce of bichromate of potash. Fill with Marietta Co.'s mahogany standard filler.

From the foregoing example we find that the first test was made as shown in the first line of quantities used. That is, the operater used 1 dram of scarlet, 30 grains of black, 2 scruples of orange and 1 dram of bichromate of potash. It is evident that there was not sufficient strength, so the next addition was 2 scruples of scarlet, 30 grains of black and 1 scruple of orange. This did not produce the desired result. The third experiment, or addition, produced the result by the addition of 20 grains of black. This, then, gave a pint of stain which would do the work. A pint being an eighth of a gallon, the different amounts used were added up in grains, then reduced back to the largest units of

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the weights employed by the scale at hand. The totals give the correct amount for a gallon of stain. It is then an easy matter to double or increase the amount to any number of gallons desired. The card becomes at once a record and when filed away numerically with the sample of wood received, the sample will show the result from the stain made. This makes an additional record which at any time can be called for to assist in future experiments. Should there be another order taken in where the shade varies little, you have a basis to work upon. These experiments sometimes will take from 10 to 20 additions of the various colors, but after a pint of water is used for dissolving more than a half, or possibly three-quarters of an ounce, it is recommended that you destroy the chart and begin over again as in that case the water carries too much stain and is liable to become muddy. Again, care must be taken in the selection of colors. It must be remembered that acid colors and basic colors do not harmonize. A precipitate is thrown out which is absolutely useless and a waste of color material.

CARD IS A RECORD FOR FUTURE EXPERIMENTS.

The foregoing example may be employed in the making of oil stains, but owing to the fact that oil colors do not dissolve as readily, especially if they be of the lumpy kind, unless they be heated on a water bath, the results are not so easy or sure. The preparation of a concentrated solution of the colors usually employed for making oil stains is very handy. For instance, the finisher of experience knows what colors are usually employed for making the various oil stains. Consequently he can make up a certain quantity of a very strong solution of the colors, the strength of which is known to him. He can then proceed very much as in the previous example, or according to the following, the chart of which is shown below:

RECORD CARD FOR OIL STAINS.

OIL STAIN EXPERIMENT CARD NO. 569

Match for sample board from A. S. Muellen Company "OLD OAK."

Benzole	Oil Red	Oil Yellow	Oil Black	Acetone
½ pint	1 ounce	2 ounces	3 ounces	1 ounce
	½ ounce	¼ ounce		
½ pint		¼ ounce	1 ounce	
1 pint	½ ounce			1 ounce
2 pints	2 ounces	2½ ounces	4 ounces	2 ounces

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The chart is then carried out by multiplying the amounts with whatever factor is desired to produce the quantity of stain required. As there are eight pints to the gallon, in order to make the above into a gallon quantity we would multiply naturally by four. Multiplying the entire amounts by this figure would give us a total of eight pints of benzole, eight ounces of oil red solution, 10 ounces of oil yellow solution, 16 ounces of oil black solution and eight ounces of acetone, which the operator has found to produce an oil stain, which will match the sample board in question. My readers will notice that this formula will produce one and one-quarter gallons of stain. For all practical purposes this slight increase will not matter, but if that quantity should be too large, it is an easy matter to reduce the factor.

CARRYING OUT CHART.

The adoption of a system of this kind in any finishing department where mixing of colors takes place,

No. 8 SCALE

is far ahead of the old style, which was taking a little of this and a little of that, and then some more of this, without keeping or having at hand a record of where the stock came from, and with nothing but memory to rely upon. A finisher who once starts a system of this kind will eventually become possessed of a valuable lot of information. The more of these charts he has, the more readily he can match a special order.

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CHAPTER III.

THE STAINING AND COLORING OF WOODS

THE first efforts at staining or coloring woods were primarily undertaken to embellish them. Our native woods were colored in order to give them the same shade as those of the tropical woods, which are so much more expensive, and also to color cabinet woods, producing deeper shades and to give them the appearance of age.

ART OF STAINING ESSENTIAL IN GOOD FURNITURE.

Of late years, all sorts of colors and shades have been produced. Many of the colors have nothing in common with those of the natural woods, such as the green, olive, gray and blue tones, these especially being absolutely foreign colors. Stained woods are today very popular, the buying public demanding strong colors, so that the art of producing these colors is becoming more and more a requisite in the building of furniture.

The literature which is offered seems to be a compilation of traditional information, each succeeding effort containing parts of some previous publication, with a few additions. In applying the word Stains to the furniture industry, it can be classified as covering all the different processes which are employed in the finishing room and which tend to change color, to produce shades or match woods. No matter what method is employed in finishing, it is called staining, with the one exception, which is fuming. But the staining methods must be subdivided so that, when afterward referred to, they will be recognized.

Under the head of Sanding, some details and requirements for successful treatment are given. That they may not be overlooked, let me briefly refer to a few essential things. These are the preparation of the wood by sanding, and in some cases, by sponging and sanding afterward, for it should be remembered that some of the woods must be sponged and sanded down again before the stain coat is applied.

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The production of stained woods, however, demands that, as much as possible, the characteristic texture and growth of the wood should be absolutely retained. Not only should they be retained, but the stain should, if possible, bring out the beauties of the wood. All materials employed in the production of stains, anilines, dyes and chemicals as well, should be absolutely soluble in water, or if used in spirits or oil vehicles should be equally soluble, so that they will penetrate as much as possible into the wood and carry with them their color value without destroying the natural appearance of the wood. Therein the well stained wood has an advantage over a wood stained with insoluble color materials, as the former penetrates, and in its process of penetration lends its color to the fibers and cells of the wood, whereas the latter tends to cover, and thus destroy the natural appearance.

STAIN SHOULD ENHANCE WOOD'S BEAUTY.

Of a stained wood, we demand, from the fact that the furniture is to be used indefinitely, a permanency that will not be affected by either light or air. Yet these two requisites are not the only ones that are essential in making a good stain. There are a good many dyestuffs and chemicals which are fast to light, but they are not adapted for wood stains. A good wood stain, one that will be fast to light, and permanent to exposure to air, must have the necessary penetrating quality so that when spread upon the wood will penetrate the fibers and pores alike, tending to leave an evenly colored surface. The application must be simple, the results certain and, as a rule, must not be exorbitant in price.

REQUISITES OF A GOOD STAIN.

The various anilines, vegetable color stuff and chemicals used in the production of stains have a varied qualification as to their permanency when made up as stains. We have a good many anilines whose colors are most beautiful, and from which every conceivable shade can be produced, but unfortunately within 24 hours after their application they begin to fade. Another series of anilines permits the exposure of months, withstanding all without a particle of change. As a rule, coal tar colors are far in advance in their qualifications as stain material in preference to veg-

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etable products. It is an easy matter to produce any shade of stain out of the two thousand available aniline colors. But it takes an intimate knowledge to ascertain which of these colors is adapted for use in the coloring of woods.

The demand for these special colors has so increased in late years, that the consumer is comparatively safe in ordering supplies if it is known by the supply house for what purpose the colors are to be employed. Without discussing here the relative values of oil stains and spirit stains, suffice it to say that the general rule is, from the very nature of production, neither spirit stains, nor oil stains, can be said to be absolutely permanent. But their permanency can be greatly augmented by the after treatment of the wood, such as covering or coating it with an air-tight coat such as shellac or varnish, thus protecting it from the oxidizing effect of the atmosphere.

PERMANENCY AND FASTNESS OF A STAIN.

For the artisan, it is well to know that, as a rule, a color that is absolutely soluble in water, as well as in alcohol, is not fast to light. Where it becomes absolutely necessary to produce shades by the employment of colors of unknown permanency, it is far better to apply each coat separately. To be explicit, let us suppose we wish to use a red and a black, but the effect of the two colors mixed is unknown to us. Then apply one color first, and when thoroughly dry, apply the second color. Thus the uncertainty of the mixture is avoided, but the result on the wood is obtained. In the event of producing stains out of coal tar dyes and chemicals, it is well to remember that it is not safe to go beyond two ounces of chemical salts to the gallon of water. There are instances, however, where a quantity as high as four ounces of chemical material can be dissolved in a gallon of water. This depends largely upon the amount of water of crystallization present in the chemical.

In the application of vegetable dyes, one should always thoroughly understand the mordants that are to be used in the making of permanent colors when employing this material. As a matter of fact, vegetable colors should be obsolete, from the fact that their very

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nature does not spell uniformity. For it must be known that no two plant lives produce results identical. There is always a discrepancy in the actual percentage of color value present in a given weight of material. While the few that are still popular, such as log wood, fustic, catechu, can be purchased in extract form, and thus partially eliminating the uncertainty, there is nevertheless, a percentage of uncertainty, which although small would manifest itself in the results. And although the popular mordants would be employed, assuring the permanency of the resultant color, the shade might vary.

KNOWLEDGE OF MORDANTS NECESSARY.

Then, too, standardizing the stains made from vegetable dyestuff would exact an amount of labor the expense of which is not warranted in the face of the fact that an aniline of absolute permanency, producing identical color values, can be purchased at reasonable figures. Therefore it is not considered timely to recommend continuance of materials prone to uncertainties.

While mineral colors, as far as permanency is concerned, are recognized superior to any stain material, from the very fact that they do not change their physical condition while being applied to wood, yet they must not be considered a stain. Their only considerations in good furniture are in their filler coats, and their value of giving to the filler a harmonious shade conforming with that of the stained wood.

The fact that a thin coat of stain ofttimes is not considered permanent, whereas a stronger stain made of the identical material is called fast to light, needs consideration. For example, if we coat a square yard of a certain wood, employing ten grams of color materials, and then coat another square yard using but one gram of color material, it will be found that after a given time the sunlight has produced a greater effect on the weaker stain. The dark coat will have lost possibly one-half gram of its color material, say about 5 per cent. However, the lighter shade will have lost about 50 per cent, and will have the appearance of a faded-out surface, which will show us that in producing the light shades, the effect of sunlight must always be taken into consideration.

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But it must be understood that it is not the stain that changes the color, but it is the wood itself that has changed and thus affected the stain. This can be carried on further, and show conclusively the permanency of the stain, by taking a freshly sanded panel and exposing it 48 hours to the sunlight, applying the weaker stain, and again exposing it to the sunlight, when it will be found that there is no perceptible change in the stain. This again convinces us that after the permanency of the stain is established in delicate tones, light effect on freshly sanded surfaces must be taken into consideration in the final result.

WOOD CHANGING AFFECTS THE STAIN.

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CHAPTER IV.

KNOWLEDGE OF WOODS NECESSARY.

ALL woods entering into the manufacture of pianos, furniture and other high class commodities intended to receive a clear and durable finish should be thoroughly seasoned and well dried. We are living in a fast age. The rapidity with which the monarch of the forest is converted into the beautiful article for the home is but characteristic of the times, and calls loudly for a care that in some measure at least will compensate for the haste in the preparation of the wood for the finish.

WOOD MUST BE SEASONED AND DRIED.

Until quite recently both in England and Europe, and even in this country, it was customary to allow wood to stand several years between the time it was cut from the tree and the time of manufacturing it into household articles, in order that it might become thoroughly cured. But in this age of action much lumber is used in the manufacture of goods that has been cut but a few months at the most.

Wood intended for furniture, pianos, etc., that has not been thoroughly seasoned in the open air should be thoroughly kiln-dried a considerable time in advance of being made up. This is of advantage to any wood whether thoroughly seasoned or not. But it is imperative with wood that has been rushed from the tree to the dry-kiln. If poorly seasoned wood is hastened from the dry-kiln into the workshop it is very easily affected by atmospheric changes, and constant expansion and contraction result from a continually varying temperature. On the surface of such wood a lasting finish need not be expected.

When the highly polished, mirror-like surface grows dim before its time, either the method or the material used in finishing is usually held accountable, and all eyes are turned toward and centered on the finishing room as the source of the trouble. A careful examination of the finish reveals the fact that the surface of

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the varnish is gradually growing uneven, and this unevenness is the cause of the dimness. But what is the cause of the unevenness, is the question demanding an answer.

In many finishing rooms unevenness of finish has been for years, and is today, one of the unsolved mysteries.

UNEVENNESS OF FINISH TROUBLESOME.

A microscopic unevenness will adversely affect a high polish. If wood has not been properly dried, no matter how well the pores may have been filled, or how carefully the varnish may have been rubbed and polished, there is certain to result, in consequence of expansion and contraction, an unevenness sufficient to detract from the appearance of the finish soon after the work is done. And this trouble may continue indefinitely without its cause being ascertained, because men persist in looking for the cause of trouble in the immediate vicinity where the trouble is discovered. It is here that science enters and enables the finisher with a well trained mind to stand out from among his fellows and clear the path of obstacles that are immovable and insurmountable to the average man.

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CHAPTER V.

PREPARATION OF WOOD BEFORE FINISHING.

WHILE it is generally understood that all wood should be thoroughly dried before it is finished, this really means that it should be thoroughly seasoned before it is put into work at all. Unquestionably there was no better method than the old way of storing it in the rafters of the work shop for five or six months, where it was subjected to the circulation of the air, and was always in a dry place.

OLD METHODS GOOD BUT TOO SLOW TODAY.

The stacking up of lumber or boards, sometimes said to be done to take out the warp before the present-day kiln-drying, is only a step toward the preparation of the wood. It shortens the time in the kiln. In the present day of hurry and hustle, the old methods, no matter how meritorious, will not do, because competition will not permit of tying up capital for so long a time, and, therefore, it may be said that all cabinet woods are prepared by drying them in the kiln.

One would naturally suppose that this was an entirely satisfactory procedure, but it is not without difficulties, for the softer wood, when hurried too much, will shrink beyond normal, only to take on a certain amount of moisture after having been in work. To exemplify, take a piece of basswood, subject it to excessive kiln-drying, and, for argument's sake, say it has been reduced to nine inches. You will find that it will increase, in a perfectly dry room, to about 9½ inches. If this piece of wood were immediately put in work, the atmospheric conditions would later cause trouble. The preparation of the wood, therefore, to a certain degree, must be in keeping with the peculiarities of the wood.

After the wood has been thoroughly seasoned, it is usually cut to sizes, when it is ready for the planer; from the planer it goes to the sander, when it is passed to the various machines, preparing it for the cabinet room.

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The foregoing procedure is that of the furniture factory, whereas the general preparation of the wood for the various kinds of wood-working industries is similar and supplied to the different industries as kiln-dried stock in the rough or planed.

The stock thus prepared is ready for the cabinet room, where it is made up into the various pieces and again smoothed down before going to the finishing room. Large surfaces, such as table and dresser tops, are put through the polisher or sander machine. Sanding is employed wherever possible. When a piece is finally finished and thoroughly smoothed down, it is turned over to the finishing room. The sanding of large surfaces is a delicate operation, particularly so where veneer is employed. Here the danger of cutting through the surface of the veneer comes, for which there is no remedy except to send the piece back to the veneer room to have it re-veneered. This is done over the old veneer, as the surface has already been smoothed in the polisher or sander. Turned parts are sanded before they leave the lathe.

FINISHING PROCESS IS COMMENCED.

Unusually rough parts are drawn down with a scraper. This, however, is only necessary when extremely uneven joints have been made. Here the cabinetmaker uses his plane or scraper. Where hand sanding is done, the cork block or, nowadays, the rubber block, is employed and usually garnet paper is found to have the preference. It will be seen that no matter what the work, the general preparation of the wood before it reaches the finishing room results in thoroughly seasoned stock and, when made up, perfectly smooth work.

A piece thus prepared, and particularly is this the case of medium and better grade work, where water stain is to be employed, is now sponged. This sponging is usually done by one man, who has a large pail of lukewarm water in which a small quantity of glue has been incorporated—not enough to act as a sizing, but sufficient to cause the fibers of the wood to dry stiff or to hold up the fuzz. After the sponging the smoothing process is employed. In pieces where large surfaces are to be smoothed down, as much as possible is done in

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the knock-down. By this is meant the various tops. Drawer fronts can then be done with machine work. After the entire piece has been sponged and smoothed it is ready for the finishing room.

The question naturally arises, why do you sponge and sand when you intend to apply another solution of water stain?

SANDING AND SPONGING.

This accomplishes one of the main features of good finishing. It has opened up the pores of the wood. The loose fibers have been removed and this enables the finishers' art to enhance the beauty of the wood. First, it does away with the extreme amount of sanding which is necessary to smooth the wood after the grain has been raised by the sponging process which, if the stain were incorporated with the sponging solution, would cut off too much of the stain coat, and in some places, possibly, cut through, leaving an unevenly-colored surface. That a considerable amount of care must be taken in the sanding process, especially with the softer woods, is generally known. But for the novice, let him take various kinds of woods, and he will notice that he can cut down into the soft parts of the wood, leaving the flakes of the fibrous parts protruding. That is why it is well to employ a fine, but high grade, sandpaper in smoothing the surfaces, whether before or after staining.

SPONGING IS OMITTED ON SOME GRADES.

On the cheaper grades of work the sponging process is omitted. It means two less handlings of the article. On work that it to be oil stained, or spirit stained, sponging is also omitted; but in either of these cases a thorough dusting is quite essential, if a clean bit of work is to be the result.

In the general preparation of the wood in carvings, turned work and curves, there is no special method to be recommended. The turned work is sanded in the lathe, carvings by hand, curved work by hand or machine, but in all cases there is end wood to be considered in the staining process. If it is found in work that is to be sponged, it is merely a case of thoroughly sanding and smoothing down before staining. No general precaution is necessary with a water stain, and especially is this the case in the darker shades; but if the

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end wood takes on the color too dark, it is merely a case of proportionate thinning of the water stain so that the increased amount of stain deposited in the end wood will only come up to match that on the general work. But in cases of oil stain, it is absolutely necessary to greatly reduce the strength of the stain, so that the end wood will not show up darker than the general color of the entire piece. This end wood should all be stained before the balance of the piece. This rule equally applies to the filler. It can readily be seen that end wood would take on more stain and more filler than the smooth flat surface.

PRECAUTIONS NECESSARY MANY TIMES.

These precautions are employed where the best of results are desired, and, unfortunately, are never considered in the cheaper grades of furniture. Where the dipping processes are employed these precautions are simply out of question. Built-up stock and veneers are all sponged and treated like solid woods where water stains are employed. It would surprise any one to know how small a quantity of wood is taken off in the sponging process. That is why we are able to sponge the veneer parts in the same manner that we do solid wood. If this were not possible, the results would not be uniform. It has been stated that the sponging method is employed only where water stains are used. While this is general, there are exceptional cases where the wood is sponged in order to open the pores, such as in making fumed oak by the use of an oil stain, or where some of the fancy finishes are to be made, and the pores to be later filled with a colored filler.

In these cases, the wood is sponged, and in order to more readily open the pores, a small amount of alkali is added and then, when dry and sanded, the pores are still further opened up by the use of a picking brush. After the sanding has been completed, the work is thoroughly cleaned off before applying the stain and before applying the filler. This is also necessary in cases where precaution is necessary to keep the filler from settling, from the fact that the oil penetrates the wood, leaving the dry filler to still farther settle in the pores only to be followed by all the subsequent coats in the finishing process.

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The difficulty that affects the finishing room is usually that which is termed "cutting through." After the wood is sponged, it is put through the polisher, which is a machine usually supplied with No. 1 down to No. 00 paper. The operator of this machine has the most responsible sanding position. He must smooth the piece without cutting through the sponged part. The great danger is in using too coarse paper, and then cutting through part of the wood which has been affected by the sponging operation. Thus he entirely eliminates the sponge part, and while bringing a smooth piece to the finisher, causes the difficulty which cannot be recognized until it has passed through the cabinet room and is ready to receive its final treatment.

THE DANGER OF "CUTTING THROUGH."

The foreman finisher unsuspectingly puts the piece through the staining process, only to find that the color has not taken evenly. The particular part which was cut through did not take the stain as evenly or as deeply as the rest of the piece. Then and there the difficulty begins. It means "doctoring," with doubtful results. When the finishing department thoroughly understands its requirements, it should be consulted in the matter of purchasing sanding machines.

Usually the builder of such machines informs himself of the requirements and the results necessary to be obtained with the machine before he puts it on the market. In these days, when time is money, when wood is getting scarcer, when the finishes are of a much higher grade than they used to be, the sanding operation is one that must not be overlooked.

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CHAPTER VI.

THE IMPORTANCE OF GOOD SANDING.

BEFORE staining woods, it is absolutely necessary that every part of the piece has been thoroughly sanded.

GOOD SANDING ESSENTIAL TO GOOD FINISH.

As a rule, the machine sanding, when done by experienced operators, needs little attention; but the necessity of the sanding operation, as a whole, is recognized by the foreman finisher as absolutely essential to good finishing results. Untold troubles and difficulties may arise from too much or too little sanding. The finisher must insist that sanding be done with the grain: First, with the coarser sandpapers until toward the finishing of the sanding operation it is smoothed with the finest paper.

An experienced hand will never attempt to go crosswise of the grain. The use of the sanding block, which is usually made of a block of wood three by five inches, to which is glued an absolutely square piece of cork, is common. About this is placed the paper that is used. It might be well to state that sandpaper should not be torn. Place it face down, cut the paper side, and then break over an edge. In this way absolutely even work can be produced by regular strokes and uniform pressure.

I will not enter into the merits of the various sandpapers on the market, for every operator has a choice, and once he is accustomed to the results he obtains, it matters little what brand of paper is employed, as long as a satisfactory surface is produced. A method employed which takes the place of sponging the wood before staining is the sanding, or rather smoothing with wet pumice stone. This method is not popular in this country, but is used in Europe quite extensively. It is claimed that better results are obtained by its use, and one operation eliminated. The wood is moistened with sponges to raise the pores, and then rubbed smooth with pumice stone and by the use of the sanding block.

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For this process it is claimed that the water stain, described later, will penetrate the wood better without raising the grain so that the sanding or smoothing after the application of the stain is reduced to a minimum. In this country, the sanders deliver the piece supposedly completely sanded to the finisher. For many of the stains it is sponged, and quite thoroughly at that, and again sanded before the stain is applied. The difference seems to be in the fact that the cutting of the moistened surface with pumice stone to absolute smoothness has a different effect than sponging, letting it dry and then sanding.

REDUCING THE SANDING TO A MINIMUM.

One of the text books published in Leipzig, Germany, tells us: "Wood is in all probability the most difficult material on which to produce an absolutely even surface. The structure of the same is so varied; beside the soft, fleshy part are the bone-hard fibers representing the years, or age, of the tree. In oaks which are quartersawed we call them the flake. In some woods the structure is tough, hard and pithy; in others, short and stocky fibers. Therefore, to sand woods even, and so that the flakes and soft parts are equally affected by the process, the soft parts should not be crushed down or pressed together, so that they will not swell up later, the hard parts not to protrude by the sanding process. In other words, so that there will be no depressions and elevations, but that the surface will be absolutely even. The following requisites are specific of a good sanding or smoothing material: First, it must be sufficiently hard and sharp so as to attack the hard parts of the wood and, at the same time, to cut the soft parts of the wood rather than to press them together. Second, it must be produced chemically so that the wood will not knot itself, but will powder up and be readily removed with a duster."

We see that sandpaper figures extensively in the manipulations which go to make the finished product. First, the raw wood is smoothed, and so is each consecutive coat until the last one, which is usually rubbed. After sponging, staining, shellacing and filling, it is sanded. Different degrees of sanding, different degrees of fineness of the sandpaper, all of which must

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be thoroughly understood by the foreman finisher, are applied. He must understand how to break in his men. A new hand will do more harm than good. In these days of finishes of woods, such as Circassian, where there is really little coating, scratches or cuts by negligent sanding loom up like a boil on a man's nose.

Sandpaper, used on finish, must be kept moist. Old finishers usually split their paper and then moisten the back. This is so that the paper will give way under pressure rather than to press in on the soft part of the wood. An experienced sander will have at hand a sponge with which he moistens his paper as he uses it. Today you can purchase sandpaper that is coated on both sides, and on which a split is started so that when you come to use it, it is merely necessary to pull it apart.

MUST HAVE KNOWLEDGE OF SANDPAPER.

There are various makes of sandpaper, some have preference in one factory, and some in another. The main thing is to know what degree of coarseness or fineness to use, and then to see that the men use it properly. No matter what woods are used, the surface cannot be prepared too carefully. As stated before, whether sanding is done by machine or whether it is done by hand, it must never cut through the sponged part of the wood. That part which had been raised by the moisture should only be sanded sufficiently to give it absolute smoothness. After staining (of course, we mean water staining, as spirit or oil stains will not raise the grain), it is only necessary to cut off the little fibers or nap that may protrude. Some finishers, particularly where the cheaper grades of furniture are made, prefer to put on a coat of stain without sponging, usually relying on their results by putting on a heavier coat of stain or a darker coat and sanding lightly afterward. They even fill the wood without sanding, put on the shellac and cut the protruding fibers which are stiffened by the shellac by giving it a light coat of sand. The only danger of this operation is that these little fibers will show up the raw color and will not permit a permanent finish, acting as conductors of air, especially where wax finishes are used.

Shellac coats and varnish coats are, of course, hand

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sanded, No. 0 and No. 00 paper being used. It is impossible to lay down an ironclad rule for the operation. Enough has been said to show the reader the points to be safeguarded, but the factory that wants good finishing results must insist upon the fulfillment of the essentials conducive to good results in the finishing room.

SANDING FOR UNIFORMITY OF RESULTS.

Uniformity in sanding is essential, and to properly convey this to the finisher, the following experiment is suggested: Plane a piece of wood, making a smooth surface. Sand one surface with No. 00 sandpaper and the other with No. ½ sandpaper, and stain both surfaces. This will exemplify in a strong manner what it means to the finishing department if uniformity in sanding is not insisted upon. The planed part of the board will be light in color. That sanded with the fine sandpaper will be darker and that sanded with the coarse paper will be very much darker, and the coarse one will give a muddy finish.

Another precaution is the sandpapering between each application of finishing material. For instance, after the filler has been applied, there are likely to be spots where the filler has taken darker, due to a little roughness generally caused by insufficient sanding in the cabinet or machine room, which may not have been noticed until the filler showed them up, and which, in the finished product, would show up a blotchy bit of work. It is a fact that it is difficult to clean up filler, or wipe it off, on the so-called "skipped" places, and in consequence thereof a bit of judicious sanding will greatly help the final result.

Varnish surfaces may be sanded without creating the least bit of dust, if the sandpaper is wet with oil before it is used. For this purpose a shallow dish should be procured and partly filled with oil. The sandy side of the paper should be wet with the oil, after which the paper is used just as in dry sandpaper. After using the sandpaper for awhile, it will become clogged, but may be cleaned to a large extent by brushing it out with a wet brush, after which it should be dipped into the oil again. Use a substitute turpentine or a mineral oil. Sandpapering with oil does not retard the work;

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on the other hand, it seems to help it. For some kinds of varnish sanding, steel wool is recommended as economical and labor saving, but experience has shown that it is dangerous to the finish.

That there should be a great many details in the manufacture of sandpaper seems, at first thought, rather remarkable; but when one stops to consider the large variety of material which goes to make paper, the different ways of making it, the innumerable substances which are used in glue, and the wide range in their prices, not to consider the various factory methods, it is not strange. If the different grades of paper were limited to only ten, and the glue to ten, we would have one hundred possible combinations without even considering the sand, grading or care in manufacture.

MANY VARIETIES OF SANDPAPER.

The process of making sandpaper has been specialized to a degree which seemingly allows but little possible improvement, and the production is so low in price that it is poor economy to use inferior paper, quality being so important that it outweighs every other consideration.

The most important quality of the paper is strength; not strength in one direction merely, but in every direction. Paper, designed for sandpaper, is of two kinds: Cylinder and Fourdrinier. The cylinder has strength all in one direction; the Fourdrinier paper has no grain, the fibers being distributed in such a manner that the strength is equal in every direction. Fourdrinier paper will not tear in a straight line. It is made in combinations of fiber in different thicknesses, according to the grit to be applied.

Few people realize the adhesive power of the best glue, and sandpaper demands the finest. It has to be specially made and must be very elastic. When it is considered that fine glue has cohesive power equal and even superior to glass, the importance of the right glue can be readily understood. The glue acts not only as a binder, but aids materially in strengthening the paper.

The term "sandpaper" is a misnomer, as sand is not used, the material, instead, being crushed flint rock or quartz. Flint rock, when fractured, presents the sharpest edges procurable, whereas natural sand, examined

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under a microscope, will be found to have a rounded appearance, the cutting edges being considerably dulled by the action of wind and water.

The garnet paper is made by the use of garnet ore, which is secured in the United States and abroad. It is not quite as sharp as flint rock, the particles fracturing in right angles, but the edges being more durable than flint.

HOW GARNET SANDPAPER IS MADE.

In grinding flint or garnet the material, in the form of large chunks, is first passed through crushers, which are graduated to produce the desired grit. The material is then carried to sifting rollers, which are, in reality, skeleton cylinders covered with fine bolting cloth. The material passes through the inside of these cylinders, which are placed at an angle, the larger pieces passing out at the other end, and only the finest material being sifted through. The sifted product is next passed through a series of vibrating separators, which determine the different sizes with extreme exactness and uniformity.

All kinds of sandpaper, emery paper and emery cloth are made in rolls as large as that used in the printing of a daily paper. The process is continuous to such an extent that while the paper is still coming from the roll at one end, the finished product is being re-rolled at the other end. The first step in the process is the printing of the brand, which is done by passing through a roller press. The paper next dips into the glue, which is applied very hot, rubber buffers preventing it spreading to the other side of the paper. From this it passes under brushes which distribute the glue evenly. It next passes under a shower of the grit desired, the surplus falling off by gravity at the first turn. A further application of a thin solution of glue gives an extra coating which thoroughly cements all the particles. From this the paper passes over a hot blast dryer, and is suspended in long loops, traveling slowly for a considerable distance, to be finally rolled into a finished state. The sheets are cut by running the paper from the rolls through a cutter which drops them out, automatically counted, and delivered so that they can be assembled easily in quires and reams.

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To determine the quality of paper, tear it from each edge. Good paper will not tear straight readily. It does not tear cleanly, but the fiber pulls away, leaving an irregular edge. This characteristic should be the same, tearing from all four directions. When bent, the paper should give a good snapping sound, and when bent sharply the particles should not loosen and drop off. Another test is to rub two pieces from the same sheet together. This is a very severe test, but good paper will give up its grit with extreme reluctance, not showing the paper beneath without considerable rubbing. Above all things, keep sandpaper in a dry place, away from an open window where there is a possibility of its absorbing moisture from the air.

THE TESTING OF SANDPAPER.

If the paper gets too dry and cracks or breaks when fastening it onto the drums, moisten the paper on the back before attempting to place it on the drums. This will do away with that trouble.

Every user of sandpaper should know, if he but stops and thinks about it, that moisture is injurious to sandpaper and that it should be thoroughly dry when used, no matter whether it is paper to be used by hand or paper to be attached to a roll sander or any other sander device. Moisture and heat both tend to soften the glue holding the sand to the paper, and to let the sand strip off, thus shortening the life and impairing the usefulness of the paper.

Those who know this thoroughly perhaps often fail to appreciate another fact, and that is that sandpaper in stock will go and come more or less with the weather. It will absorb moisture from the air during rainy weather and should be dried before using.

MOISTURE IS INJURIOUS TO SANDPAPER.

Indeed, it is well to treat sandpaper pretty much as one treats veneer before using it. No matter how well it has been taken care of, treat it to a little drying in a warm room to insure drying out all of the moisture before using it. This may seem a little matter, but it is attention to small matters of this kind that often marks the difference between fairly good work and entirely satisfactory work. Surely if there is moisture in the sandpaper that will soften it, it is worth the time it takes to thoroughly dry the sandpaper before using.

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CHAPTER VII.

THE PROCESS OF STAINING WOODS.

STAINING is a branch of finishing that requires a man naturally adapted for the work to produce the best results, and even then he must give it his best efforts. Each and every stain has its own peculiarity, and the man using it must be able and willing to adapt himself to the requirements of the stain he is using. Many troubles of the finishing room and many a headache that the foreman finisher endures have their inception in the staining room.

FOREMAN FINISHERS SHOULD HAVE APTNESS.

All stains should be put on quickly. I make no exception to that rule. No matter if it is an oil, acid, spirit or water stain, in order to insure satisfactory results in every detail speed must be used in applying it. If one is staining mahogany veneered work with water stain, it is necessary to cover the surface in the least possible time in order that the brush may not work up any of the glue that may have been squeezed through to the outer edge of the pores.

Speed is also necessary to insure a strictly uniform depth of color throughout the surface. It is also necessary to have a uniform way of doing things. By that I mean to do the same thing the same way each time. Have some system. Suppose a man has a batch of 50 mahogany sideboards to stain. The first thing to do is to stain the unimportant parts such as the back, bottom and inside of the board on your bench.

There are various reasons for doing these parts first, but the chief one is this: If the more prominent and important parts were stained first and one were to allow some stain to run over an edge, or get any stain on these prominent parts after they have once been stained, it is liable to show up after goods are varnished unless the utmost care is exercised in removing it. Whereas any stain that may run over on these parts, while they are yet in the white, will be lifted and worked out when the regular coat is applied.

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Then have a place to start and a place to stop. Most finishers work to the right, so in order to illustrate what we mean we will start to stain at the top of the left hand gable. It will facilitate matters greatly if we stain the edge of the top as we go along, wiping it off immediately. This will prevent the possibility of it becoming daubed and spotted. Staining the gable, we proceed to the edge and the inside of the pilaster. This done, we stain the front edge of the top, wiping it off immediately, and proceed downward, staining the drawer and door divisions. Then up the truss and pilaster on the other side and around to and down the right hand gable. Now the case is all stained except the top, which is stained last. In staining the flat of the top we will put but a light coat on the edges, which have already been stained and wiped off. This will give the edges the same depth of color as the rest of the case.

THE NEED OF FOLLOWING A SYSTEM.

By going about the work in this systematic way one can do more and better work, with much less labor and worry. I have seen men stand before a piece of work, perhaps a large china cabinet, or some other such article, dreading to commence, fearing they would make a bad job of it before they got through. This would not be true if they would plan out the best way to proceed and follow it strictly.

In staining mahogany one will frequently find a piece of plain wood alongside of a nice piece of African stripe. This is more likely to be found where solid wood has been used in connection with veneer. If this plain wood is left so, it will not look well after it is finished. An easy way to grain these plain parts is as follows: Make a small quantity of stain double the strength of that used on the case, ordinarily. Stain the case in the usual way with the regular stain and when about half dry (the surface must still be showing moisture); take a small camel hair pencil brush and with the dark stain stripe the plain parts to match the balance of the wood. If the first coat is not allowed to become too dry before the stripes are put on, the dark stain will flow out nicely to a fine feather edge and be sufficiently like the genuine to puzzle the most expert.

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To get the same depth of color on Cuban mahogany as on African mahogany, a stain about one-half stronger is required for the former than for the latter.

Birch may be treated the same way except that the stain for this wood, if it is to match mahogany, must be double the strength of that used on the mahogany. Some stainers in staining articles with both birch and mahogany put two coats of the ordinary stain on the birch. They stain all the birch parts first, and when these are dry they then stain the whole article.

GETTING THE SAME STAIN SHADE.

Frequently a stainer has difficulty in getting hand carvings dark enough. Mahogany being a soft wood and the carver an expert, he is able to make complete, clean, perfect cuts, which require no sanding to make them perfectly smooth. But here is where the trouble lies—they are too smooth. The depth of color will be regulated by the absorbing qualities of the wood and an absolutely smooth piece of wood can absorb very little color. There must be a loosening of the fibers to enable the wood to absorb the color. This can be done best by sanding. As previously explained, the coarser the sandpaper the more fiber will be loosened and raised, and the more of this loose fiber there is, the darker the stain will take. All mahogany carvings, therefore, should be sanded before staining if the proper depth of color is to be expected.

In staining case goods, an air of refinement is lent to them if the inside is stained about 50 per cent lighter than the exterior. Open up a sideboard, dresser or wardrobe, and everything else being equal, if the inside is lighter than the outside, one is impressed with the distinguished appearance of the whole thing. The dark exterior, by the law of contrast and harmony, gives the interior a chaste appearance while the latter by the same law increases the richness of the color effect of the exterior.

STAINING INSIDE OF CASE GOODS ADDS REFINEMENT.

I have read that a water stain should be put on with a sponge, but I have never been able to find the man who could give me the reason why. A sponge is the proper thing to use for sponging the wood before staining. It will help to loosen and lift the fuzz which is to be sanded off when dry. So far as possible the object

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desired in sponging is to be avoided when staining. The less fuzz raised with the first stain the better.

A rubber-bound polar bear hair brush is the best thing with which to apply water stain. In putting golden oak stain on large plain surfaces a more uniform job can be made if the stain is applied with a cloth, using the ordinary fitch brush for the smaller parts. A fitch is the proper thing to use in applying turpentine stains, such as most of our Early English and weathered oak stains are.

BEST METHOD OF APPLYING WATER STAIN.

If a piece of stained wood which has not had a coat of any other material, has a patch of stain scraped off and it is desired to re-stain so that it can never be detected, proceed as follows: First, stain the patch with the regular stain and allow it to dry. The patch can now be distinguished by a narrow border darker than the rest and which is caused by the stain lapping. Now take a small quantity of the regular stain and reduce it one-half and apply a coat of this to the whole surface. When this is dry, the border caused by the lap will have disappeared and the patch cannot be found.

In applying an oil stain, it is necessary to spread the stain out quickly, especially on oak in order to prevent the large open pores drinking in more than they can properly dispose of. Extreme care must be exercised in this respect when staining end wood. In staining veneered work the stain cannot penetrate deeper than the glue; but in solid oak of the softer varieties, the stain will penetrate to a considerable depth.

One frequently sees oak furniture with the stain oozing out of the pores in places. This is usually caused by one of the three following things: Working so slowly that the stain is allowed to penetrate to a considerable depth before being brushed out; coating too heavy with the stain, or filling before the stain has sufficient time to properly dry. Stain allowed to penetrate to such a depth goes beyond the reach of air, and consequently cannot dry in the time usually allowed for that purpose.

After the goods are filled and perhaps varnished, the stain deep down in the pores begins to generate a gas which creates a pressure beneath the filler, and

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soon it throws out the filler and varnish and begins to ooze out itself. But it does not always wait until the wood has been filled before this action takes place. One may wipe the stain off clean and on examination after the goods have stood for a few hours, find a little circle of hardened stain around each pore as evidence that the oozing has already commenced.

ONE GREAT DIFFICULTY WITH STAIN.

When one finds himself confronted with a condition such as this, he must call a halt and either give the stain considerable extra time to dry, or do something to extract it from the pores. In any event he should dampen a cloth with benzine or something similar, and remove the circles from around the pores. This will likely give the wood in the immediate vicinity a faded appearance. The proper thing to do then is to rub the whole surface affected with the cloth, making it uniform. Then take a little stain on another cloth and rub it over the surface. This will restore the proper shade.

If the goods are wanted quickly, and it is thought that to allow the stain to dry out thoroughly will consume too much time, much of the stain may be extracted by applying to the whole affected surface a good coat of benzine, working it well into the pores. Wipe this off and apply a second coat, wiping it off also. Allow a few hours for drying, keeping an eye on it to see that any stain that may continue to ooze out is wiped off before it hardens. Then take some stain on a cloth and apply a light coat to the surface, allowing very little to enter the pores. This will restore the original color which was destroyed by the benzine.

If stain oozes out after the goods are filled and varnished, it is not remedied so easily. Usually the better way will be to remove the varnish, wash out the pores with benzine and refinish.

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CHAPTER VIII.

THE CLASSIFICATION OF STAINS.

STAIN materials, as employed in the production of stains, cause our stains to be classified as water stains, oil, spirit, and again as acid or alkaline stains. Without a doubt those produced by dissolving the color material in water give us the best and most satisfactory medium for the coloring of the wood.

WATER STAINS ARE THE MOST SATISFACTORY.

Artisans have argued that as in most cases the sap of the wood in the natural tree is mostly water, the wood from this tree more readily absorbs a liquid of the same nature. Therefore, when the color is dissolved in water, a more even pentration is obtained. It also penetrates farther, owing to the fact that the evaporation of the water is not so rapid as that of alcohol or any of the coal tar solvents usually employed. Again, the water soluble color material at hand exceeds all of the others combined.

In describing stains, we have said that the material employed designates the name. In the trade a finisher immediately knows what materials are apt to be employed when he is told that a water stain was used. He immediately seeks his supply of materials from anilines. If he is told it is an acid stain, he infers that chemicals are employed and it may be in conjunction with an aniline color.

Spirit stains of today would indicate an aniline, soluble in alcohols. Oil stain would indicate an aniline soluble in oil. By these oils, however, is meant turpentine, but more often such hydrocarbon compounds as benzole, xytol, etc. In the alkaline stains he would look for ammonia, soda or potash, as the case may be.

The terms have simply been brought out by the use of the materials employed, and as there has never been a definite basis upon which to build stains, it is the intimate knowledge and practice that has brought out to the artisan an understanding of the terms employed. The present-day demands upon the finishing depart-

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ment are so varied that a familiarity with all the methods used to arrive at a result should be known in that part of the factory. The more varied the line, the still greater are the demands on the finishing end.

That water stains supply us with practically every shade that is desired or in use is a conceded fact, and that they are not always used is usually a matter of dollars and cents in regard to the cost of the finished article. We do not know of any style that could not be produced with water colors. Of course, there are always these exceptions, that small obstacles may arise from the use of the water stain, such as thin veneers and delicate woods, and in these places the oil color or the spirit color is usually brought into play.

WATER STAINS PRODUCE COLOR SHADES.

The comparative value of these stains, and it must be understood that we are talking of the present day method of production, is all in favor of the water stain, particularly in regard to its permanency and fastness to light. Spirit stains and oil stains will fade, the percentage, however, varying greatly in accordance with the colors. Thus it will be seen it is unadvisable to use a combination of stains on any one job. Spirit stains are usually used for quick work or for touching up, and that is all the consideration they should be entitled to when their qualifications in regard to permanency are considered.

Oil stains are usually employed on the cheaper grades of furniture, and where the finish is put on so heavy as to thoroughly protect them against the air. The effect of the light is then greatly modified owing to the fact that the light is without the assistance of air and in consequence oil stains are claimed to be permanent. On the interior of case goods, oil stains are in favor. They do not require the subsequent sanding, and the variations of shades due to the wood are not objected to as they would be on the outer surfaces.

We do not consider plant extracts in our industry, as they are practically off the market, and it is difficult to obtain them of a uniform strength. We mention acid and alkaline stains. Generally speaking an acid stain is one in which we find chromic, acetic, tannic and pyrogallic acids, and in which the solution has an acid re-

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action stronger than that of the anilines, although usually they are employed in conjunction with an aniline.

The tannic and the pyrogallic, however, form the basis of brown shades produced by the subsequent application of alkalies. These alkaline stains, we said, were made out of the volatile alkali, ammonia and the fixed alkali of soda and potash salts. We say a volatile alkali when speaking of ammonia and it is well to remember that word. Ammonia itself is a gas, and the only way we can handle it is by the absorption of a certain amount of this gas when it is run into water. This, however, is not a fixed or definite proposition. Every time it is handled, the amount of ammonia gas is reduced. Stains in which ammonia is employed should be made up fresh, and to be accurate should be made according to hydrometer tests.

ACID STAINS INTRODUCED.

Uniformity of color is the great essential. After a stain is once found correct, the greatest difficulty is to keep it uniform. This is a difficult proposition where ammonia is employed. Therefore, the fixed alkalies are preferable. In general, alkalies produce a brown shade when applied to wood, and this peculiar action is taken advantage of as much as possible without injury to the wood, to the brushes, or the hands of the operator.

In this method of staining, the volatile alkali, ammonia, has an advantage over the fixed alkalies. For after it has been applied and the work done, nothing remains on the wood that could produce a deleterious effect upon the subsequent finish. However, where the fixed alkalies are employed, if the amount be too great, their presence on and in the texture of the wood is apt to affect the subsequent coatings, through their saponification of the oils employed in the finishing processes.

UNIFORMITY OF COLOR AN ESSENTIAL.

Alkalies, in conjunction with the chrome salts, are very popular just now in producing the various shades of brown, and bring what we call a strictly chemical stain, in aqueous solution, penetrate deeper, and in consequence a more satisfactory result is obtained than from staining which leaves a superficial coloring. Thus it will be noted that alkaline stains have a decided alkaline reaction to litmus paper.

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Before touching upon the reaction through which still deeper colors are obtained, by the use of the two diametrically opposite stains, alkaline and acid, just a word or two of the trade's conception of an acid stain. It should be a stain made up of acids and have an acid reaction, but unfortunately, any stain in which chemicals are employed, and which have a corrosive action on the wood and particularly on the hands, is termed an acid stain. Thus it will be seen it is judged by the effect rather than from the material of which it is made.

HOW AN ACID STAIN SHOULD BE MADE UP.

Acid stains are few, but the acids employed in conjunction with materials held in solution in acid re-acting liquid should be termed acid stains. Not only are they made up of acid re-acting stain materials, but as a rule an excess of some acid is present which still further facilitates penetration and color. Simple acid stains, such as solution of tannic acid or pyrogallic acid, produce very little color in themselves; chromic acid produces a greater amount of color; picric acid a decided yellow. When this acid is used, in conjunction with a nigrosine, we produce the popular Early English, and the acid has a double purpose in its yellow color; it produces the olive black typical of Early English stains, increases the penetration of the stain, and acts as a mordant for the aniline.

Speaking of the results obtained by the use of the alkaline stains, and the acid stains, it is understood that this depends upon two separate applications. One could not mix the two and obtain the results. The chemical change which takes place must take place in the wood, in order to produce the color. It is exemplified particularly in the production of fumed oak, by the first coat being of tannic and pyrogallic acid and the subsequent coat, a strong alkaline solution of bichromate of potash, and possibly other chemicals, showing clearly that the two entirely opposite compounds when applied separately will produce colors in strength in direct ratio to the quantity of color chemicals employed.

We have spoken of oil stains and spirit stains. Where the simple coloring of wood is desired, they give us a very quick method of producing a color which is ready for further finishing in a very short time. Those

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of experience know the delicacy with which it must be handled in a subsequent procedure. Spirit stains, owing to the fact that they dry quickly, penetrate correspondingly less. Oil stains may penetrate more, but both are apt to lift with filler coats or shellac. The spirit stain is apt to color the shellac and thus be unevenly deposited on the work.

WATER STAIN GIVES BEST RESULTS.

A comparison must determine judgment upon these various stains as to their qualifications for producing the best results. They all have a place in the finishing room, but for general good work, the water stain seems to give best that which is wanted.

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CHAPTER IX.

STAINING WITH CERTAINTY OF RESULTS.

MANUFACTURING today calls for time limits, and this affects the finishing as well as other departments. Stains, therefore, should be prepared so that the application in the regular manner will produce the desired color without any after-staining or restaining. Those that are preferred make it possible to obtain the desired color with one application, or possibly two applications of the same stain. It is a peculiar fact that, as a rule, repeated coats produce diversified results.

PREPARING STAINS SO AS TO AVOID ANY RESTAINING.

In chemical stains the color production depends upon the chemical reaction of the first coat in conjunction with the color-giving materials naturally present in the wood, and the chemicals applied in the second coat of stain. Chemical stains differ in their results inasmuch as the actual chemical change that takes place is definite, and can be ascertained before the application of either coat. The variance, therefore, that may take place is due only to such color-giving materials as naturally may be contained in the wood.

To overcome this uncertainty, usually an excess of that which nature has furnished is applied, so that when the second coat is applied the chemical change depends upon the amount of chemicals in the second coat, and, therefore, is definite. An example of this is found in the present methods of producing brown, such as fumed oak, by the application in the first coats of tannic and pyrogallic acids, and the subsequent chemical change which takes place when a solution of potassium bichromate, potassium carbonate, copper sulphate, stronger water of ammonia (26 degree) in water, is applied.

It sometimes becomes necessary, in order to produce odd shades, to use two different anilines. We said "different" because they may be of different series, that is, one color might be known as an acid color, and

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the other as an Alizarean color, or a basic color. No two of these colors could be mixed in one solution, and therefore the shade may be obtained by the application of one, and when this is thoroughly dried, the second one is coated over the first. This is not recommended, but it shows a means by which the end can be obtained. After the wood so colored has been finished, the color is usually permanent, but not always. It depends upon what combinations were employed, and how thoroughly the finishing coat protects it, and the amount of light that the product is exposed to.

PRODUCING ODD SHADES.

The cost of production is a question ever present with the manufacturer. Those who recommend water stains are confronted by the arguments of those who recommend oil stains, and of those who recommend spirit stains. The consumer of stains, that is, the man who actually is in charge—the foreman finisher—undoubtedly is the controlling spirit in each factory, and, as a rule, the methods favored by him dictate the supplies of that factory.

THE FOREMAN FINISHER DICTATES SUPPLIES.

If he is using water stains, he can tell you to the penny how much each gallon of stain costs; he is usually familiar with all the colors, chemicals and dye stuffs that are required for the production of a stain. The more he handles them, the more he becomes acquainted with their peculiarities and thus he is more capable of circumventing any of the eccentricities that arise occasionally wherever chemical and kindred mixtures are made.

A factory, as a rule, is quite unlike a laboratory. Things have not been brought down to the nicety which the chemist has learned by experience must be present in order to have accuracy. The dried residue of a previous mixture may go unnoticed in the use of a measuring glass or container, and the amount of damage done to the new mixture is not realized, until, perhaps, an entire mixture goes wrong, the reason for which is afterwards ascertained by experiment or otherwise. The natural precaution then would be that every vessel, dish or container employed in the finishing room be cleansed thoroughly before it is again put to use.

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We stated that the finisher employing water stains would be confronted with arguments from those employing other stains. He will be told that the necessary sanding overcomes that difference in cost which he saves from the fact that water stains are cheaper. This statement I doubt very much. Gallon for gallon, a water stain will go farther than an oil stain; it will go much farther than than a spirit stain. Except for the sanding expense, each costs more than the water stain, and owing to their quick penetration, neither will go as far as a water stain; and, lastly, they are not as permanent.

WATER STAIN IS THE MOST WORKABLE.

Further, there are but very few chemicals, if any, that are soluble in either oil vehicles or spirits. Therefore the colors depend on oleic or stearic derivitives of the anilines, or that series of anilines which are soluble in spirits. Another peculiarity is the fact that oil stains are used in factories where quick results are desired. Spirit stains do not enter into the furniture industry to any great extent, and, therefore, may be dropped from consideration here.

However, since the advent of denatured alcohol the cost of spirit stains has been reduced greatly. They all have their places, and it is a fact that one cannot do what the others can do. A manufacturer of cheap wooden toys who can immerse them into a water solution of color by the basketful, and which sell for a few cents, would not be expected to dip them in a spirit stain, costing 10 to 20 times as much. Thus the selection of the stain must be governed by the work at hand.

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CHAPTER X.

GENERAL RULES FOR STAINING WOOD.

WOOD staining not only requires the production of a stain, and the application of the various stain solutions, but the rational application of stain and a certain amount of knowledge of the different woods in regard to their adaptability and susceptibility toward a certain stain. With one and the same stain different results are obtained when applied to various woods. This is due to the very different chemical constituency of woods, which tannin or tannic acid, which is present in larger or smaller quantities, produces on many of the stains, chemical action varying in results according to the quantity of this chemical present.

RESULTS VARY WITH SAME STAIN.

Two examples will explain: First, in applying a solution of two ounces of bichromate of potash in a half gallon of water to a species of wood, such as pine, or similar wood which contains a very small amount of tannin, the result will be that of a light yellow due to the chrome bichromate, which unfortunately is not fast to light, and, therefore, in this case is worthless. On the contrary, if you take the same bichromate of potash solution and apply it to any of the oaks, which are rich in tannin, the results will be a yellow brown color, comparatively permanent when subjected to light or air. This is due to the fact that the tannic acid present unites with the bichromate, forming a brown color material. Similar effects are to be had when this bichromate solution is applied to mahogany or black walnut, as both of these woods contain considerable tannin.

Second, stain whitewood or any wood in which the tannin is practically absent with a solution of sulphate of iron, one ounce, water one gallon, the result will be negative. However, if the same solution should be applied to ash, oak or even maple, a gray color will be produced and on the oak it is very often possible to

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get the dark blue grays verging into black. This is obtained from the fact that sulphate of iron, or in fact, any salt of iron, when subjected to the action of tannic acid produces tannate of iron, which is the color-giving result of the procedure.

RESULTS ARE DEPENDENT ON TEXTURE.

The different textures of the woods, designated hard and soft, have a good deal to do with the results obtained by the application of the stain. In a closely grained wood of a hard texture the penetration of the stain is retarded, when on the contrary large-pored wood absorbs more stain, much quicker, with the result that an ordinary application of one stain on the two different kinds of wood will produce vastly different results. If one wishes to match the hardwood with that of a soft, it will be necessary to increase the strength of the stain, which is far preferable to the possible application of several coats of stain. In case of matching the hardwood by staining a soft wood, the stain will have to be reduced in proportion. This is recommended only after repeated tests have been made. A porous wood might give indications of being dry, and as tests are usually hurried the operator is apt to fool himself and to find later the results are too dark.

LOCALITY INFLUENCES THE COLOR.

A certain stain applied to a certain species of wood may not always give identical results, and in consequence the operator must be continually on his guard, as various growths and various localities will affect the stain with enough difference to manifest itself in the color produced. A thorough operator soon becomes aware of these peculiarities, and by applying the stain heavier or lighter he will succeed fairly well in holding to a uniformity of shade. Extreme cases, of course, need individual attention.

Woods containing a great deal of sap, or resinous matter, present their difficulties especially when water stains are employed, but as they are not much employed in good furniture and as we have already touched upon the handling of the stain, it will suffice to say that occasional resinous portions that are met in cabinet woods are better individually treated. Where stains depend upon the presence of a certain quantity of tannin, the formula usually employed is built up so

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that the minimum amount of tannin present will suffice to make the color desired; otherwise the application of tannin is resorted to.

It may be said that stains consisting entirely of the aniline dyes, in solution, reach their final shade much sooner, and with much more uniformity, than those which are made up of combinations of dyes and chemicals. It may be stated as universally true, that where chemicals are employed, some sort of chemical reaction is relied upon to produce the desired color. Therefore, it will be seen readily that when the material to be stained is not always alike, although the same kind of wood, yet of sufficient difference in its physical constituency to make possible slight variance, from 24 to 48 hours are required for the complete chemical reaction.

ANILINE DYES MORE UNIFORM THAN OTHERS.

Stains containing chemicals should be permitted to dry from 24 to 48 hours in normal temperature, in rooms that have a good circulation of air. Whatever chemical changes are to take place will have been completely consummated within this lapse of time.

Where more than one coat of stain is required to produce certain colors, it is always best to allow at least 24 hours between each coat. Sand the first coat after it is thoroughly dry, and then apply the second coat. This is just as essential, whether the stain is made up of anilines or chemicals, the desire always being to produce a stain that is permanent. It may be well to state again that not all color materials permit being dissolved in one vehicle without injury to one another. That the novice may thoroughly understand, and further have a method of ascertaining and recognizing the fact when any of the rules are infringed upon, the following explanation will bring out the point:

We have said there are several kinds of anilines. The acid anilines and the basic anilines, both are water soluble. The finisher, however, is unable to tell to what group they belong. It may be he has a beautiful shade of brown which has been doing his work, and he wishes to employ it in conjunction with some other colors. Not knowing that they are antagonistic, he makes his mixture which may not at once manifest the

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chemical change that is about to take place or is taking place. Later on, however, a precipitate which is first recognized by the turbid appearance of the solution will show that the chemical reaction which is taking place is throwing part of the color material out of solution, and the stain, therefore, has become an unstable compound. As long as any chemical reaction takes place, there is an uncertainty about the color. This, however, has a fixed and definite place as soon as the acid has been neutralized by the alkali. The chemical action ceases, but in dealing with two color compounds, where the chemicals are aniline salts we are treading on pretty thin ice in an effort to obtain a color, and, therefore, it is always best to discard any attempt at producing a stain by the use of anilines of different reactions.

ANTAGONISM OF VARIOUS ANILINES.

This undoubtedly will find some exponents who have had satisfactory results by having done just what we say not to do, probably for this reason: They use material far in excess of the amount required, and thus overcome that which was lost by precipitation. The excess color having precipitated out, left in solution enough color material to produce the result. It will be seen that this is an expensive and uncertain way because at different temperatures there would be more or less precipitation, with a probability of a turbid solution which at its best is not a satisfactory stain.

In a measure this applies to chemicals. It may be known that one chemical applied to wood will produce a certain color, and if a second chemical be applied over that coat a different color is produced, but that in no way signifies that the two chemicals may be mixed in solution and with one coat produce the same results. Again, for example, if wood is coated with an iron salt, the usual color is a shade of gray. If a strong alkali is dissolved in water, and put over this gray coat a brown of some shade is produced.

If you take any iron salt, and dissolve it in water (practically all iron salts are soluble in water) and add to this solution any form of alkaline salt, or alkali, such as potash, soda, or ammonia, or their salts, such as carbonate of potash, carbonate of soda (respectively,

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salts of tartar or sal soda), a brown precipitate is the result. The brown precipitate is represented as the oxide of iron. The balance of the solution will contain the acid radical of the iron salt as having combined with the alkaline base of potash or soda. We have then a cloudy solution, which cloudiness is due to the oxide of iron, and which will settle, and leave in the solution the salts of the alkalies, whichever may have been employed, showing us clearly that by application of the same material in separate coats it was possible to obtain a certain color on the wood, but that it is not at all feasible to attempt to do it in one coat by putting the various materials into one solution.

A PRACTICAL ILLUSTRATION GIVEN.

By giving our readers such a strong illustration it carries with it an exemplification of that which is often attempted, and the failure not recognized. If our readers will but take the time to carry out the last example and make practical experiments, the resultant information will be invaluable.

Producing solutions of anilines, dye stuffs and chemicals should always be carried on with a certain degree of care, and especially cleanliness. Water being the most commonly employed solvent, a certain amount of care is to be given. It is a well known fact that certain waters are hard, especially those taken from wells. Some may contain magnesium, and some iron, but in most cases they all contain more or less lime. The different percentages of any of these present affect the color materials in their same ratio. It is best, therefore, to employ boiled water, or in a factory to obtain the water from the returned steam. The dishes or containers employed should be absolutely clean. Nothing is better than earthenware and glass measures. Solutions are best obtained by employing hot water. The maximum amount of color material can be dissolved at increased temperatures. Thorough solutions are obtained by powdering the dye stuffs, by stirring and agitating while dissolving the material, and by increasing the temperature by boiling the solution.

GREAT NEED OF CARE AND CLEANLINESS.

An excess amount of color material may be brought into solution by boiling, which will again solidify or precipitate out when the temperature falls to normal.

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Let it be understood that the application of heat is used only to hasten the dissolving of the color material.

In the case of vegetable extracts, such as logwood, japonica, cutch, etc., uniformity is absolutely necessary. If they are kept exposed to air, which carries with it a certain amount of moisture, these materials are apt to absorb this moisture, and then take on a thick, gummy consistency, difficult to handle, or if kept in extreme hot or dry places, they are apt to cake, and then become difficult to remove from their container.

EXTRACTS EXPOSED TO AIR DIFFICULT TO HANDLE.

All chemicals should be kept in air-tight containers; especially is this necessary in factories where there are more or less vapors and gases to contend with. There is ever present in air, carbonic acid gas, which in itself is a chemical reagent to which color materials are susceptible. It will readily be seen if a chemical formula, a stain formula, were made up from material received in prime condition, that it is absolutely essential the material be kept in that condition until it is consumed for the sake of uniformity. Much of the difficulty, the continual doctoring of formulas, is traceable directly to the indifferent handling of the materials, dirty dishes, uncovered containers, in fact, complete disregard for any of the physical peculiarities which are so common to dye materials.

Having obtained the formula, make a record of each ingredient; weigh carefully, and take care that a complete solution is made. If an article is given you as water soluble, the success of your formula depends upon making an entire solution of it. Should the mixture become clouded, you have no way of telling what percentage of your color is going to precipitate out. The very fact that the solution is cloudy or turbid must tell you that something is not completely in a state of solution.

Every color-giving article has its percentage of solubility. Some of them are greater than others. You will find, as a rule, that the nigrosines have a greater solubility than the oranges. The same is true of most of the lighter shades. When you go beyond that percentage, heat will greatly increase the percentage of color that you cannot dissolve. But it is not safe to at-

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tempt this remedy unless you can apply the stain hot. While we recommend the dissolving of colors by heating, this is more to hasten the solution than otherwise. The complete solubility to be employed is that which will stand at a temperature of about 50 degrees. Your solution must remain clear at that temperature. Should it precipitate out, as it many times does, where water stains are subjected to freezing temperature, it should be dissolved again by heat, for be it known that crystallization takes place by the chilling of saturated solutions.

HEAT WILL INCREASE PERCENTAGE OF SOLUBILITY.

When a chilled solution begins to crystallize, the crystallization takes from the solution a larger percentage of color than one can realize. In some cases it almost exhausts the solution of the color material that had heretofore been in complete solution. Therefore, in cold weather, when your stain begins to run light, the above may give you a cue for remedying the trouble. Again, in some mixtures, the chilling may affect one color and not another. Alcohol mixtures are not so easily affected. Oil mixtures are very seldom affected, but oil colors will crystallize, especially where the solvents are loaded to obtain the desired shades.

The practical man at once will recognize that if he dissolves his color material by the aid of heat, and it precipitates when it again resumes the temperature of the room, he has a super-saturated solution, and he will have to increase the amount of water or decrease the amount of material. There are cases where it is necessary, in order to get the depth of color, to use super-saturated solution. This is sometimes the case where dipping is employed, such as small parts, and in these cases the solution is kept at a boiling point by the injection of steam by means of a steam jet.

The careful operator filters his stains, and a felt filter is a most desirable stain room accessory.

COLOR MATERIALS SHOULD BE KEPT DRY.

All color materials, whether anilines, vegetable extracts or chemicals, should be kept in sealed packages in a dry, but not too warm room. Many of them have a peculiarity of absorbing moisture from the air. Others give off moisture. It is not uncommon to take a can of carbonate of potash and on opening it find it

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in a white granular salt. Put it back on the shelf without sealing it, or closing the can, only to find the next time you want it, it has liquified. If any of it remains so you can put it on a scale, you cannot say with certainty whether the ounce or two you are weighing out represents the same strength that the first portion you took out represented.

This is a case of absorption of moisture from the air.

MOISTURE IS ABSORBED FROM AIR BY SOME COLORS.

Again, you may have a pound of sulphate of iron crystals. When you received these crystals they were bright green, glass-like particles. Going through the same procedure, you will find the next time that each crystal is coated with a grayish powder, and if you weigh the same quantity of this sulphate of iron in its second condition, you will have a vastly larger amount of sulphate of iron in your second weighing than you did in the first. For sulphate of iron in its crystalline form contains a large amount of water, and when it is not kept in an absolutely air-tight container, it will give off some of this water of crystallization with the result that a large percentage of sulphate of iron, known as dried sulphate of iron, is present.

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CHAPTER XI.

THE APPLYING OF STAIN TO WOOD.

THE various stain solutions are usually applied cold. Occasionally they are warmed in order the better to penetrate the wood. The application of stain, as a rule, is accomplished by the use of brushes, preferably rubber set brushes. The brush is to be filled well with stain material and the actual staining accomplished with full, strong strokes of the brush. This because of the fact that a comparatively dry brush will tend to streak the work. This is particularly true where large surfaces are stained.

STAIN BEST APPLIED BY BRUSHES.

Where the wood presents open pores and large pores, a stiffer brush should be employed. It may be necessary after the first stain is applied to use one of these coarse, heavy brushes to rub the stain well into the wood, for often these coarse pored woods will not take the stain as well as one would naturally expect. The pores are filled with air cells which must be broken before the stain can penetrate, and unless this be cared for the result will not show the uniformity that it should. It always must be borne in mind that staining is an effort to make it appear as though the entire wood through and through is the color as that being applied.

SPONGE USED WITH STRONG ALKALINES.

While the vast majority of stains are applied by means of brushes, there are cases where it is impossible to do the work with a brush. Stains, in which strong alkaline solutions, such as ammonia, the carbonates, hydroxides of soda or potash, are employed, or strong acids, or strong oxidizing chemicals, such as permanganate of potash, are better applied with a sponge or brushes made of vegetable fibers, such as tampica, hemp and wood fibers.

Whenever a stain curls the hair in a brush, no matter how trifling, it is better to do away with the means of application than to continue, for the very good reason that as the brush is subjected to the stain it be-

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comes less efficient, and the results will be manifested in an uneven appearance of the stain coat; once stained it will be difficult to make an even job of the effort. The preparation of the hair or bristles has more or less to do with the lasting quality of the brush.

From their very nature bristles that have not been cured to an excess will resist more or less alkali and in the same manner they will withstand an acid. When the stain brush is cleaned out, after it has been used, in a very weak acid solution, and washed out in plain water, permitted to dry, and immersed in a penetrating petroleum oil, use any of the lighter paraffine oils. The market affords a water-white paraffine oil put out as liquid vaseline. This is an ideal brush preservative.

AVOID BRUSH WITH HAIR CURLING.

Neutral oil which can be obtained at 25 cents per gallon will do very well. After the brush has been immersed in this oil over night, it may be taken out and thoroughly dried by rubbing on rags or waste until it no longer gives off any fatty or oily substance on clean paper. Brushes treated in this way will give an immense amount of endurance. It would be natural to suppose that a brush prepared in this manner would not carry the amount of stain that it did in its original state. This, however, is only the case for a few minutes after it is again employed in staining. But the tenacity of the bristle, the resiliency, is more permanent throughout the day's work than if a brush is not prepared to withstand the inroads of the chemical substances, the action of which on the animal fiber is not withstood by some substance not affected by the constituents of the stain. Stains which are slightly alkaline or acid may be applied with bristle brushes. The foregoing suggestions rather cover those with a slight acid reaction, but the coal oils do not answer readily to the weaker alkalies as they do not saponify when brought in contact with alkalies.

NEUTRAL OIL PRESERVATIVE FOR BRUSHES.

In cases where it is absolutely necessary to apply strong alkaline or strong acid stains, the hands may be protected by washing them in heavy oils, such as cylinder oil, or better still, by thoroughly coating them with vaseline. Especially is this recommended for the tips of the fingers, under and around the finger nails, and

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the back of the hands. Then in applying the stain with a sponge, the sponge should be previously immersed in the stain solution, which is absolutely foreign in nature to the vaseline on the hand, and in consequence thereof it will spread the stain without removing enough of the grease from the operator's hands to have any effect on the wood.

PROTECT THE HANDS BY OIL OR VASELINE.

The few moments required to prepare the workman for handling these strong stains and the expense of keeping at hand a few pounds of vaseline, which can be purchased in the open market, are slight. It may be well to say that in calling for vaseline, which is put out by an individual who has the word "Vaseline" copyrighted, the purchaser is apt to be confronted with a stiff price. The United States government has recognized this product under the name of "Petrolatum," and as such it is supplied by any of the petroleum companies at lower figures. It may not be as highly refined, but its efficiency is nevertheless satisfactory. Incidentally the same protection can be employed where strong acid solutions are used in staining.

These precautionary measures are well to consider, as the trend of times is manifestly toward chemical stains. The dominating shades employed in wood finishing have been brown and at the present time they are brown, but occasionally have verged on black. A peculiar fact is that the two shades, exclusive of the reds, are dependent upon the chemical reaction which the latter-day chemist has found for the finisher. Classing them as a whole with their modifications and their extremes, every one of them can be produced by the use of chemicals.

DOMINATING COLOR STAINS ARE BROWN.

Granting, then, that sooner or later such stains will be preferred, it is well to know how to handle them advantageously. Two strong factors confront this method of coloring woods: One, which is ever present in human endeavor, is the results obtained through the minimum cost; namely, the putting of a certain amount of aniline dye in a given amount of water, and spreading it on the wood producing a color the quickest and cheapest way, just good enough to sell. The other, from the fact that the industry is yet a rule-o'-thumb propo-

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sition when it comes into the finishing department.

No reader will admit that a brown color spread on wood will give the same shade as that produced by the lengthy, more expensive method of actual fuming. There is something superficial about the one; no matter how much after-fixing may have been done, it does not produce that wholesome appearance that the fuming brings forth. It has not been so long since a fuming box was considered an expensive luxury, but today very few concerns that rank as producers of high grade furniture are without their fuming box. The fuming process not only produces fumed oak, it produces what is known as "English Fumed Oak," "Stratford Oak," and may be used as a basis for many of the other oaks, were it only true that the subsequent application of chemicals and the great possibilities were realized and understood by the artisan of today.

FUMING NOW CONSIDERED AN ESSENTIAL.

Granting then that the fuming box has been recognized as a valuable adjunct, that the aniline dyes have made a vast stride over the obsolete methods of juices, extracts, or vegetable plants, we will soon enter the era of chemical staining. This in no way means that anilines are to be superseded, for they are chemicals, complex chemicals, which unfortunately are not thoroughly understood. The writer claims that each day we are gaining ground in the matter of understanding better the chemical peculiarities of these delicate color-giving chemicals. The desire to make something better, to be a leader, is a road fraught with countless difficulties. Few venture away from conventional methods.

Innovations in procedure are not countenanced by many heads of industries. They fear disaster from experiments. Enterprise, originality, personal initiative by the man at the head of a finishing department, are given little or no financial support. It is a case of get out the work, and never mind experiments, and thus many an idea is lost. The man feels that he has given all that is asked of him when the daily routine is carried out.

Again, new methods are not taken to kindly. The usual reply is, "Our goods are selling; why should we change?" But there comes a time when an individual

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drifts away from the rut, and does start something. A few people put in fuming boxes; competition has made it necessary for many others, who wish to equal the standard, to do likewise, and so it will be in the process of staining. Better furniture will find a market. Attention to little details will find appreciation, and when competition finally recognizes the value of detail there will be a scramble in the effort to meet the competition, and thus will be recorded one more stride in the betterment and advancement in the method of producing good furniture.

BETTER STAINING METHOD COMING.

In preparing a classification of stains for the reader it will become necessary to generalize and to group such that depend upon kindred mixtures for results. For example, many stains come under the brown shades, whether on oak or mahogany; yet fumed oak will stand out by itself. The mahogany and the cherry stains will constitute another class with the distinction that those applied to mahogany are differently constituted than those which are applied on cherry; whereas their color material may be very similar. In bringing out classifications of this kind it is with the view of giving a comprehensive survey of all stains that are now in general use. We believe that a thorough understanding of the basis of the present day staining will bring the reader up-to-date, and upon which knowledge it will be possible to build a future along the line of the more advanced theory of producing absolutely permanent, but transparent, colors on our cabinet woods.

GROUPS OF STAINS.

In order to do this, we must dismiss some of the older methods of producing colors on wood, claiming that a stain implies the act of giving a color to the wood absolutely transparent, and not in any way producing a color by spreading over the surface of the wood a solid particle, no matter how finely divided a state it may be in. That, in our mind, would be and should be classified as paint. There are books written on finishing, and articles appearing in periodicals, in which formulas and methods are given for producing some of our popular colors by means of paint pigments. These are mixed with oils and spread over the wood, producing a shade not unlike that of a stained piece of

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wood, but they are not transparent, and as before said, should not be regarded as a stain.

In the painter's trade it would be a different proposition; many old houses in perfect condition are planned to be finished in harmony with the general color scheme of the day. In cases of this kind, the ground work constitutes the first coat, and the imitation is accomplished by graining. Therefore, we do not disparage entirely the old methods in case of necessity or where materials are not obtainable; but in production of furniture from the raw wood we advocate the application of the modern method of staining, meaning the production of a transparent color that gives to the wood the color preserving the natural beauty and still having the appearance of being nature's product.

SHUN STAIN MADE OF PAINT PIGMENT.

Broadly speaking, the four classifications will cover all the stains now employed in the industry: Black, brown, red and green, and probably in the order named. In their varying shades, down to grays, they are produced along similar lines, and the same of the browns (except in the case of fuming), the reds and the greens. All have a similarity. The final result, however, in many cases, is affected very much by the filler employed. Let it be borne in mind that not too much dependence should be placed in the filler assisting in the production of the desired effect. Time has shown that in the ages and the mellowing of the shade, which only years can produce, if too much of the finish depends upon the filler, the original appearance is not maintained, and a decided difference is shown between the flake and the pores. This is not desirable, and especially is it manifested where oil stains have been employed.

FOUR CLASSES OF STAINS.

It is not our province to enter into the various constituencies or peculiarities of the materials employed in the modern methods of staining. This field would be so vast that an undertaking of this kind would mean a book of technical knowledge which could be comprehended only by those having been prepared in chemistry and other scientific fields. Suffice it then to say that it be taken for granted the reader shall follow the

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suggestions and familiarize himself with this information sufficiently to be able, from his experiments, to become acquainted with the reaction and the results obtained by the recommended color-giving substances; thus verifying in his own mind the correctness of these statements by producing on his own premises the results here stated.

A complete tabulation is not necessary to carry out our viewpoint. Let the modern shades of Early English, Antwerp, Flemish, weathered oak and the grays represent that part which we classify as black. They are usually produced, in the cases of Early English and Antwerp, by a black stain, modified with an orange, red or yellow, but filled with a black filler, whereas Belgian and Flemish are on the black and should be modified with sufficient red to give a faint brownish tint, but are not to be filled.

BLACK NIGROSINE THE KEY COLOR.

The production then of the key color is black. At present black nigrosine is the most popular, and can be recommended because one coat suffices to produce the shade wanted. But in olden times this color was produced from nutgalls, today represented by tannic acid and iron, or any salt of iron.

THE OLD WAY OF FINISHING.

Before the day of varnish, when repeated coats of oil were used, a depth of color was obtained which gave it that wholesome effect, the appearance as though the wood were of that color through and through. The reason is simple; nutgalls or tannic acid was not a foreign product, in fact, it was partly present in the wood. The iron solution being watery, penetrated the wood to a greater excess than will any single coat of stain, carrying with it a foreign product. It is a peculiar fact that any stain if made of chemicals has a greater penetrating power than one made up of anilines exclusively. Then, too, if this chemical solution is heated or applied warm, it will penetrate farther. If it is something that has an affinity for particles forming parts of the constituents of the wood, it penetrates still farther. This is shown in the example just given. Again, the depth of color was greatly enhanced from the fact that warm oils were applied and rubbed into the wood. The oil having the effect of driving the chem-

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ical action before it and still deeper into the wood.

VALUABLE PROCEDURE.

If the manufacturers of today would only consider the beautiful effects that could be produced by using the foregoing method, and then fume the wood, simply finishing by repeated coats of warm raw linseed oil, and doing considerable rubbing, there would be a new market, and, we claim, sufficient support to the concern showing the enterprise to take advantage of the suggestion. But today it is hurry and hurry; "get the goods out."

The grays referred to have a weak and greatly modified process. They simply follow in the wake of black, but with one distinction—on many of them an absolutely white filler is used.

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CHAPTER XII.

SPREADING STAIN ON LARGE SURFACES.

THE staining of large surfaces requires much more skill than on the smaller broken parts, and evenness is required. No matter what the cabinet conditions are, the finishing is supposed to overcome these. Woods presenting sap streaks, knotty and fibrous parts are all to be stained, with the result of a general uniformity of color. If the stain was applied alike on all parts, the end wood or cross cutting, as well as the sap part, would take on a much darker color, owing to the different density and different porous conditions that exist in these portions of the wood.

FINISH MUST OVERCOME ALL CABINET CONDITIONS.

In resinous woods, the knotty portions as a rule do not answer to the stain application and even though prepared for staining, they manifest difficulties that must be overcome if there is anything like a general uniform appearance to be obtained. In quarter sawed oaks, and their veneers, the greatest difficulty is with the sap. In general cabinet work, the difficulty is chiefly in the laying of the woods, and their selection, such as laying of white and red oak, side by side, second growth and red oak, poorly selected figures; laying the wood "up-tree" against "down tree", so that when you look at a table top on one board you are looking into the pores, and on the next one, you are looking over the pores. If the finisher matches it looking one way, when he turns the table around, he will find that it does not match at all. This is probably the greatest difficulty that is encountered in the staining of woods. Many an altercation has arisen between the finishing department and the glue room where this sort of wood joining is performed.

CHIEF DIFFICULTY LIES IN LAYING OF WOOD.

In order to overcome the difficulties thus enumerated, let us go back to the most common of all difficulties that the stainer encounters—sap streaks. Now that woods are becoming rarer the raw material is cut up

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closer, and the appearance of this unripened portion of the wood has to be dealt with: First, for the reason that the raw stock costs more money; and secondly, because a good deal of money has been put into the work before it reaches the finisher.

The following methods are recommended, and have been found from experience to be about all that can be done to even up the stain coat:

METHODS OF EVENING UP COAT STAIN.

In water stains, if, just before the stain is to be applied, the sap portion is gone over with a moist sponge so that the pores of the wood are partially filled with plain water, then the regular coat of stain in most cases can be applied. In woods that are very porous, and which take the stain more readily in consequence, it may be necessary to dilute the regular stain with water. A good deal of this may be controlled by the amount of moisture applied with the sponge. Only experience can get this down to a nicety.

In cases where oil stains are to be applied, the same process is gone through, but in place of water a coat of naphtha or turpentine, or a mixture of the two, and in extreme cases the addition of a little japan drier, will do the trick.

In case of spirit stains, it would be simpler to dilute the stain, yet the above method may be applied, but instead of using alcohol or spirits solely, about 50 per cent of water may be added to the alcohol.

Another method which could be recommended, and which is used a good deal in the larger factories, is as follows: A thin glue is prepared, and one man who is particularly adapted for detail work, is given the task to go over all the sap parts with this thin warm glue, which is permitted to dry before the piece reaches the regular stainer. This man must know his work thoroughly, for should he put on too heavy a coat he would create an impervious surface over which the water stain would spread and congeal in uneven surfaces before it would penetrate the wood.

On knotty surfaces, which as a rule take dark, and which ofttimes present an end grain, the problem as a rule is handled in an individual manner. If the knot is "dead" and free from resinous matter, the glue-size

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is probably preferable, but where it presents a resinous surface, and no water stain would be apt to take, it should be sponged with several coats of a one-half to one per cent potash solution, then thoroughly sponged off with clear water. If still further treatment is required, it can be given several coats of alcohol. As a rule it will then answer to the stain.

DANGERS OF LIFTING END GRAIN ON VENEERS.

In cases of veneer, such as crotch mahogany, there is considerable danger, by any of these methods, of lifting the end grain and causing it to check. The end grain permits the water stain to penetrate down to the glue coat, and in this manner the veneer, which is naturally weak, will raise away from its backing and become checked. It is a rather difficult proposition to overcome, and have good results without blemishes. In the treating of this crotch veneer use a filler made of gum shellac and glue, which is melted on a water bath, and then thinned with a mixture of oil (boiled linseed) and turpentine, to which enough color material is added to give it the right one. This is usually an oil soluble, red and brown. This filler penetrates the pores, or rather the end grain, and goes through to the glue coat with which it combines, holding fast the crotch veneer. After this is thoroughly dried it is sponged off with alcohol which removes the filler from the outer fibers of the wood, and leaves the outer surface in a condition in which it will receive the stain coat. After this precautionary preparation, it only remains for the stainer to ascertain the strength of the stain coat which is to be applied.

SOME MEANS OF CORRECTIONS.

Undoubtedly, the reader will ask why not use an oil stain, or a spirit stain, on this crotch work. More difficulties arise from the oil stain than are conceded, for the solvents used in the preparation of oil stains are so foreign in their make-up to the general constituency of the glue, and they have the peculiar, "puckering effect" on the crotch wood, that checking is bound to occur. Spirit stain, as a rule, is not fast to light, and again there would be the difficulties of the matching of either the oil stain or spirit stain with that of the water stain, and of getting an oil stain or a spirit stain that has the same permanency of color that the

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water stain would have. The tendency would be that the crotch work, so treated, would stand out in relief from the rest of the work instead of forming the pleasing homogeneous, uniform gradation of shades, which is so carefully sought.

SHORTCOMINGS OF CABINET WORK FIXED UP BY FINISHER.

It must be understood that these special operations are intended to be employed in the production of good furniture. In the cheaper grades this detail work to a certain degree is prohibitive, owing to the fact that it consumes time, and time is money. I often question whether the expense of one man to look after and correct these deficiencies in the wood would not be recompensed by an equivalent decrease in the selling expense. It is a fact that many shortcomings in cabinet construction design are overshadowed by a good foreman finisher who produces a pleasing uniformity that covers it all, the same as a good overcoat and hat will do for a man.

In cases where dipping is employed, the sap parts will come out strong unless some precaution is taken. It has been found that it is almost impossible to overcome the differentiation of color when stained by the dipping process, and we have yet to find methods other than those described that will help us, unless it be the employment of the spraying machine, when each individual piece must be handled and looked over just the same.

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CHAPTER XIII.

THE PENETRATION OF WOOD STAINS.

AFTER the application of a water stain, there will be more or less raising of the grain, which will necessitate the subsequent sanding usually done with No. 00 sandpaper. This is not the case, however, where spirit or oil stains are employed. The smoothing of the water stain surfaces cannot be done by inexperienced help, as they are liable to cut through the stain surface. The application of a stain carries with it a certain amount of practice. It must be spread evenly, so that there will be no laps in the coat, and must be put on heavy enough to penetrate the wood. On the close fibred woods, where it is a difficult matter to have the stain penetrate, it is better to give two coats of stain to produce the desired depth of color, than to attempt to do it with one coat. With two coats of stain, usually the one sanding is sufficient. In light shades, it is especially recommended that in order to get penetration, the stain be applied warm. In woods that are resinous, the sponging with an alkali is to be recommended, but to avoid the discoloring of the wood by the use of an alkali, an ounce of ordinary washing soap should be added to the alkaline solution, four ounces of sal soda to a gallon of water. Sponge the wood with this mixture, allow it to dry, and then sponge off with warm water. After this operation, the wood is susceptible to the ordinary water stain.

GETTING READY FOR STAINING PROCESS.

It is a peculiar fact that when wood is kept in a warm place, say 90 degrees F., water stain will penetrate it better than at reduced temperatures.

Without entering into the details or classification of water stains, such as acid, alkaline, or neutral stains, being the several mixtures of color materials in water, the foregoing procedures are general. It stands to reason that on a porous softwood surface, any liquid that is applied will penetrate quicker, and in cases of this kind, the application of the stain must be done

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without stopping. The strokes must be carried out thoroughly to prevent piling up of color material at the end of stroke or at the beginning. The movements must be decisive, the brush must carry the stain freely, but not overloaded; that is to say, the brush must carry just sufficient stain to fill it so that the natural cohesion will not permit the stain to run out of the brush. In that way, the setting of the brush onto the work will not blot the work where the brush is first applied.

HOW TO APPLY STAIN ON WOOD.

The exceptions to this rule are cases where the color is produced by virtually flooding the work. In a case of this kind it would be better to dip the entire piece or its sections, and thus avoid the danger to the glue joints and veneers. Where alcohol or oil stains are applied the same precautions on soft woods are to be followed. Alcohol stains penetrate quickly; fortunately they are not generally used, but they as well as oil stains are usually quick of penetration, and their application should be guarded the same as water stains on soft woods. No provision is necessary to prepare the wood for the application, other than the dusting which, of course, it is understood should always be done before any stain is applied.

KEEP ALCOHOL STAINS FROM THE LIGHT.

Alcohol stains should be kept from the light as much as possible, and after they have been applied the furniture should be kept in dark, well ventilated places to avoid fading which is apt to take place on these stains when subjected to strong daylight, especially sunlight. Their permanency depends entirely upon being protected from the air by an impervious coat of shellac. This applies to oil stains as well. Alcohol and oil stains should not be sanded after they have been applied. It is considered they will not raise the grain, and these are the strong talking points that the makers of these stains put forth to sell them: Easy to apply, no sanding necessary, and consequently a great saving of labor. Great care must be exercised in the application of the shellac coat not to lift the stain, and spread it about in the shellac coat, as both color materials could again be dissolved in the alcohol which is spreading the shellac.

Every species of wood has a texture peculiar to itself. Each is recognized by its own characteristics.

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To retain these is just as essential as it is to color them, and if in the staining of this wood the beauty can be enhanced and the figures made to stand out, then one has accomplished an important thing. It is certainly that which constitutes a good stain. A stain coat that will obliterate any beauty of the wood, which is apparent before any finish is put on, cannot be called a good stain. To simply color a piece of wood, to change it from one color to another, is not what should be called staining in good furniture. That should be classed as painting.

STAINING IS NOT MERELY COLORING.

The workman must know what kind of a stain will bring out the peculiarities of the wood, he should know how to take advantage of the fibers, flakes, and pores by a treatment with a stain of such reaction that will enhance and bring out the sought-for characteristics. Take oak, with its simple application of a golden oak stain. Note how the center of the flake remains one color, surrounded by a circle of a darker shade with a corresponding depth of brown in its pores. These same characteristics are found in almost every wood. It is true, oak is the best example. To maintain the characteristics of a wood, the stain material must be absolutely soluble in the vehicle employed. There can be no precipitation, or no suspension of color-giving particles in the stain. If, by standing, a stain produces precipitates, then it should be allowed to stand until every particle has settled to the bottom, and the clear liquid drawn off. Many times the solubility of a color is not understood, or it is affected by other color materials employed. The raising of the temperature a few degrees may overcome this, and as long as the temperature is maintained, all the material of color value may be held in solution, but the grave danger is that the workman will permit the temperature to fall, and before it is noticed, muddy results have been produced. Again, a stain may be produced in the summer months, and this difficulty manifested only in the winter months. During the day, when the steam is on, and the building heated to 72 degrees, the stain may appear absolutely clear, but the night may have chilled it, and then a complaint is made, ofttimes, when it is

SOLUBILITY OF COLORS MUST BE KNOWN.

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too late, that the shade is falling off. Again, part of that day's work may be done from the first dippings from the vat or stock solution, and later on the stain may be drawn from that portion which contains the precipitate, and naturally, the results are not uniform.

A good stain must remain absolutely clear at a variance of temperature down to 40 degrees F. It is not necessary to provide against freezing, as in the majority of cases, any stain that will stay in solution at 40 degrees will have sufficient amount of percentage solubility in its favor to preclude any precipitation. To make this absolutely clear, let us take the following example: Suppose we can dissolve a cupful of salt into a pint of water, and get a clear solution at 60 degrees F. We find by boiling this solution, we can add two tablespoons of salt, and still have a clear solution. We have raised the temperature to 212 in order to maintain the clear solution. We know that at the 60 degrees it was possible to dissolve but one cupful.

GOOD STAIN MUST BE CLEAR AT 40 DEG. F.

Now we will take the boiling hot solution and let the temperature fall to 60 degrees and we will find that not only has our cupful of salt crystallized out but almost another tablespoonful has been added thereto, showing us clearly that when a liquid is supersaturated by the increase of temperature, we endanger the natural amount of solid that can be dissolved at the normal temperature of 60 degrees. This is the phenomena of crystallization. In short, when a liquid is supersaturated, and precipitation once starts, the remaining solid held in solution is reduced far below the normal carrying power of that liquid.

The reader will say to himself that many of his formulas are given him with directions to boil the color material. This is done, usually, for the following reason: Certain color materials made from an earthy or vegetable basis—earths that are treated with chemicals and then allowed to crystallize—give their color values to solutions in certain percentages in direct ratio to their component parts.

Take for example, walnut brown. About 80 per cent of this material is of color value, the balance being inert matter of a brownish insoluble nature, but so

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finely divided that to a certain degree it can be carried in suspension, but this percentage is dangerous to stain. Therefore the formula is built upon the known percentage that it will give off to the water when it is boiled, and will remain steadfast after it is allowed to cool down to a temperature of 60 degrees, at which time it will remain permanent. The insoluble portion will slowly settle to the bottom of the vessel, and the clear liquid then can be drawn off with absolute assurance that it will stay clear, and no further precipitation will take place. It must not be construed that this liquid is of necessity a saturated solution. It merely represents that percentage of permanent color taken from the original amount of walnut brown.

INSOLUBLE PORTIONS OF STAIN MUST BE REMOVED.

Particularly is this of interest just now when much of our furniture is made of Circassian, gum and American walnut. For if we do not take care in doing away with the insoluble portion of this walnut brown stain, the work is apt to become streaked, spotted and cloudy from the presence of these insoluble particles. It might be well for the artisan to try this experiment. After making a solution of walnut brown and pouring off the clear liquid, pour out the insoluble dregs of the solution onto a blotting paper, cover it with a box so that the wind will not blow it away, and when it is thoroughly dry, put it on a clean piece of sanded wood and rub it across the surface. The results will immediately show him what this insoluble portion of this staining material would do to his work if he did not remove it from the stain.

Many of our color-giving materials have their solubility greatly increased by the addition of a chemical or an acid, acidulating the solution and by an excess of a few per cents of acid, assuring the continual solution of a color-giving material. However, the chemical construction of stains is to be treated under a separate chapter, and, therefore, we will not enter into the details here. The foregoing is specifically intended for water stains.

Spirit stains and oil stains represent merely the dissolving of spirit soluble or so-called oil soluble materials in their respective vehicles. Their absolute

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NATURE OF SPIRIT OIL STAINS IS A SUSPENSION.

solution in many cases is obtained. But their nature has been described as virtually a suspension. Especially is this due to oil stains, for when the oil stain is applied, the evaporation of their liquid is so quick that the color under a microscope has the appearance of having been sprayed, or blown upon the surface with a powder blower. In other words, the small oil soluble particles, through a peculiar molecular cohesion, will solidify in minute particles which give a uniform color appearance to the naked eye. Yet owing to the quick evaporation of the vehicle do not penetrate the wood, but as in spirit stain produce the color by a superficial coating of the wood.

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CHAPTER XIV.

KNOWLEDGE OF VENEERS NECESSARY.

A KNOWLEDGE of veneers is a necessity to the finisher working with veneered goods, because the problems presented by this class of work, and which demand a solution, are numerous and complex. Many veneer troubles are not discovered until the goods are part way through the finishing room, and because no one present has the requisite knowledge to enable him to trace this trouble to its source, the finisher finds the responsibility placed at his door, and is compelled to confront the problem without any hope of finding a solution.

MANY VENEER TROUBLES ARE FOUND BY FINISHER.

Many of the troubles which the finisher finds arising from veneered work either have their inception in the early stages of the veneering process or are the result of an inherent weakness in the veneer itself. A great amount of fine figured veneer is very scaly. The different layers of fiber have become separated and overlap each other loosely like the scales on a fish's back. These defects in the veneer may be natural, but more frequently they are the result of improper handling during the process of cutting. These defects are difficult to detect with the naked eye unless one is familiar with them; but when one knows what they are, they may be detected easily with the aid of a magnifying glass. Then the proper thing to do is to reject all such veneer for face work.

But veneer of this kind quite frequently finds its way into the finishing room and is varnished and put away to dry. In time the goods are brought out to be rubbed, when all over the surface, running along the line of the pores, are to be seen innumerable depressions of hair-like appearance. If the varnish is only partly dry these depressions may rub out and not reappear for some time, but if the varnish is thoroughly dry these depressions at once open out in bold checks. Varnish which is not thoroughly hardened will expand

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considerably without checking. But after it has lost much of its elasticity it will check along the line of the scale in the veneer. Everything follows the course of least resistance. The continual expansion and contraction of the wood, resulting from the frequent atmospheric changes, make a continual strain along the weakest parts of the veneer, which is along the line of these scales where the fiber is broken. This strain is carried to the varnish along the same line; and when the varnish becomes dry and no longer is able to expand in unison with the wood, it breaks along the line where the strain has been greatest.

TROUBLE WITH VARNISH AND VENEER.

How is one to know whether these checks are in the veneer or in the varnish only, is a question that should be answered here. If we scrape the varnish off, it is quite possible the checks will disappear with the varnish, and nothing wrong will be seen in the veneer. This is because the raised edge of the scale has been scraped off with the varnish, and the balance lies quite flat and smooth. To the finisher who has trouble along this line I would suggest that he get a good magnifying glass and study the difference in the fiber of different veneers. In this way one may soon learn how to detect defective veneer. But where the finish is checked and the cause is in the veneer there is usually a sharp raise on one side of the check. If we draw a damp sponge over it, this sharp edge raises quickly. This never takes place when the finish only is checked.

CHECKS IN VENEER ARE SERIOUS.

Frequently the finisher is brought face to face with another and more serious problem resulting from checked veneer—serious because the check is not a natural weakness in the veneer, and made doubly serious by the further fact that the veneer did not check until some time after it had reached the finishing room and the goods were partly finished. This problem would not be so serious for the finisher, and be much more easily solved, were it not for the before-mentioned prevailing idea that the cause of the defects must be lurking in the immediate vicinity of the place where the defects first manifest themselves.

Everything has a cause, and that cause is itself the effect of some other cause; and one of the first things

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the investigator must learn is how to distinguish between cause and effect in their relation to each other. When veneer checks, it breaks and spoils the finish. That is cause and effect. But what caused the veneer to check? Shrinking! What caused the shrinking? Drying, or the expulsion of moisture. What caused the moisture in the veneer? This is the question that requires investigation, and in order to get a correct answer we may have to pass out of the finishing room and trace the veneer back to a time before it was laid. If we do this we may find that no effort had been made to keep the veneer dry or make it dry before it was laid. And then after it was laid it was rushed off to the finishing room without any thought of what effect it would all have upon the finish.

TROUBLE MAY BE TRACED TO LAYING OF VENEER.

If anything like justice is to be done the finishing room in the matter of veneered goods, all veneers should be re-dried before being laid, and they should be laid in such a way that the moisture from the glue will not swell the veneer before it is put under pressure. If the veneered stock is put into the press before the moisture from the glue has had a chance to enter and expand the veneer, there will be no trouble from this source, provided the veneer was properly dried before being laid. Veneer cannot expand under the heavy pressure necessary to properly lay veneer. Not only this, but when the stock is hastened into the press, instead of the veneer taking up the moisture, the hot cauls will drive it into the corestock where it can do no harm.

POOR WORK RESULT OF TOO MUCH HASTE.

The utmost care should be exercised to see that veneered work is properly and thoroughly dried before entering the finishing room. It is a common practice in some factories, where trouble with veneer checking is experienced, to send the goods into the finishing room with instructions to the finisher "to get a coat of something on at once to keep them from checking." No greater fallacy was ever breathed. If veneered work will check if exposed to the air before it is finished, it will check after it is finished, no matter how carefully the finishing may be done.

It is true that if heavy lumber in the green state

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were submitted to a rapid drying process without some protection for the surface, the outside would check because it was drying and shrinking faster than the inside. In the case of drying such lumber it is customary to afford protection to the outside by allowing moisture in the surrounding atmosphere until the whole substance is heated uniformly through. Then the process of drying may be allowed to proceed without danger, because it will proceed uniformly throughout the whole substance.

But in the case of veneered work it is a different proposition. The inside of the stock is already dry, and only the outside is to be made dry, consequently there is no advantage in doing anything that will retard the drying process. In fact to do so merely means to heap up trouble for the future and prolong the day of reckoning—and when that reckoning comes, all accounts must be settled with interest.

VENEER WILL CHECK AFTER FINISH IF BEFORE IT.

As before stated, veneer that will check before it is finished will check afterward, and then it will do it at a time when great damage to the finish will result. All checked veneer is hard on the finish, but veneer that checks after it is finished destroys the finish entirely.

When veneer goes bad and destroys the finish the finisher is confronted with the problem of how best to remedy the defect and make the goods pass. To repair checked veneered work, such as has been here described, proceed as follows: Rub the varnish down with oil and pumice. Oil is preferable to water because the latter will get in the checks and increase their size. In case of mahogany and other woods that have been stained with a waterstain, the water will dissolve the stain and leave a faded margin around the check.

After the varnish has been rubbed down, allow the article to stand for a few hours in order that as much oil as possible may ooze out of the check. Then apply a coat of very thin white shellac. This shellac should not be heavier than about one pound of gum to the gallon. This must be applied as rapidly and with as little brushing as possible, otherwise it will streak with the brush; these streaks will necessitate a lot of work sanding them out. If the operator merely brushes it

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enough to put it on he will find that it will flow out and not leave laps. Shellac as thin as one pound to the gallon has very little body, and when the solvent has evaporated there is not enough left to make a serious lap. But the solvent will cut rapidly into the varnish below and if the brush is drawn across it after it has become soft from the action of the solvent, it will leave ridges. The object of putting on this shellac is two-fold: First, to neutralize the oil that may remain in the checks, and second to seal the pores of the wood surrounding the checks and hold up the varnish better.

THIN SHELLAC AS FINISHER ON VENEER.

After the shellac has been put on, let it dry from 12 to 24 hours. Sand lightly with very fine finishing paper and apply a good coat of varnish. If the checks are very fine and not deep, one coat of varnish will usually be sufficient, but if the checks are bad, more coats will be required. Where only one coat of varnish is applied, the utmost care must be exercised in rubbing because if the varnish is rubbed through to the old varnish below, it will show a patch.

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CHAPTER XV.

PROCESS OF STAINING VENEER WORK.

ALL veneered work does not require the same treatment preparatory to staining. Walnut and Circassian should be finished with fine sandpaper in order to insure a clear finish. These woods are usually stained with an oil stain if they are stained at all, and therefore no grain or fuzz is raised. But if the goods are finished with a coarse sandpaper a fuzz will be raised into which the stain will penetrate in such quantities as to detract from the clearness of the finish.

ALL VENEER DOES NOT NEED SAME METHOD.

The clear, transparent finish that brings to view all the finer markings of the wood depends almost as much on the way in which the wood is prepared to receive the finish as on the process of finishing itself. Especially is this the case with golden oak and other oak finishes that are made with a very dark stain. Not only this, but the depth of color can be made to vary by finishing the wood with different grades of sandpaper to such an extent that one who is not in the secret would believe that entirely different stains had been used. The coarser the paper used to finish the wood the darker will be the effect produced by the stain; and the finer the paper used for the final finishing the more clear and transparent may be the finish. This applies to solid wood as well as to veneered work. Mahogany, both veneered and solid, is seriously affected by the way in which it is sanded.

The process of cleaning up mahogany and other woods that are to be stained with a water stain, is somewhat different from the process required for woods to be stained with an oil stain. Nearly all mahogany, and especially African mahogany, is very fuzzy and requires the exercise of all the known arts to get it perfectly smooth so that it may receive that beautiful transparent finish that shows up all the fine markings of the wood, which have made this wood so

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popular. So troublesome has this wood been that many schemes, not conducive to the highest quality of finish, have been resorted to in order to make it smooth. Some have gone so far as to use a thin glue-size on the wood to stiffen the fuzz so that it might be cut off with fine paper. But this should never be done. No matter how small the quantity of glue, it will not all come off with the sanding unless one goes deep enough to raise other and equally troublesome fuzz, and the stain will lift the glue, and both combined will make a murky surface.

AVOID USE OF GLUE SIZE TO STIFFEN FUZZ.

Others again, realizing the danger of the glue-size on the one hand, and on the other the danger of the filler gathering in this fuzz and making an equally bad job if it were not taken off, have left the fuzz on and the filler off, and have gone to the extra work and expense of applying several extra coats of varnish to fill up the pores and insure a clear transparent job. But this is no longer necessary. If one will proceed according to the following directions, trouble from this source will be reduced to a minimum, if not entirely eliminated: When the wood is ready for the final sanding moisten the surface with clear water, putting it on with a sponge. This will raise the fuzz, so that when it receives the final sanding with fine paper much of the fuzz will be cut off. Then stain the wood. This stain will also raise some fuzz, but not so much as was raised by the water. After the stain is thoroughly dry apply to the wood a coat of very thin shellac, not more than one and one-half pounds gum to the gallon of solvent. The shellac will stiffen and hold erect whatever fuzz remains, and unless the wood is unusually soft and spongy will enable one to sand it as smooth as polished glass.

SHELLAC WILL STIFFEN AND HOLD UP FUZZ.

In this sanding, as everywhere else where good results are desired, care must be exercised. Very fine paper of the best quality should be used for this purpose. If one sands too deeply the work will have a faded appearance in places. To enable one to do the work more evenly, especially on large surfaces, a soft sandpapering block will be of great assistance. Thick felt, such as is used for water rubbing, cut five inches long by two wide, makes a fine block for this purpose.

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Should any places require sufficient sanding to give the spot a faded appearance, apply a second coat of stain to the place thus sanded, and wipe it off when about half dry. When thoroughly dry apply a coat of the thin shellac. In putting on this second coat of shellac be careful and cover every spot touched by the second coat of stain, otherwise the stain will show up unevenly after the piece is finished.

SANDING TO GIVE FADED APPEARANCE.

Permit me here to lay emphasis upon the necessity of having this "wash" coat of shellac very thin, otherwise it will clog the fibers of the wood surrounding the pores and prevent the filler taking a good hold. All that is required is a sufficient amount of gum in the solvent to hold the fuzz stiffly erect in order that the sandpaper may cut it off.

The writer is aware that in advocating the sponging of veneered work with water for any purpose whatever, he is treading upon ground on which have been fought many battles between the finishing rooms and the veneering departments. In entering upon this field, I do so, not for the purpose of conflict, but in the hope that many years' experience and very careful observation may result in throwing some light upon a very vexed question.

In the first place, I take for granted that the finisher who sponges his mahogany veneer before staining is anxious to know if sponging is injurious, and is willing to discontinue the practice if it can be shown that it is so.

CONTENTION AS TO SPONGING VENEER.

I also take for granted that the veneer man is equally desirous of getting at the truth of the matter, so as to know whether blisters and other defects which develop in veneered work after it reaches the finishing room are the result of the practice of sponging, or in consequence of some oversight on the part of the veneer room, and if the latter, that he may adopt the necessary means to prevent a continuance of the defective work.

The usual cause of trouble from this source are "blisters"—the name by which loose veneer is known when it raises from the corestock. It frequently happens that stock will pass through all the various processes from the veneer room to the finishing room

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without any loose veneer being detected. But almost immediately after the goods have been sponged or received a coat of water stain, the veneer is seen to blister in places, and, of course, the man who has not been trained to delve to the bottom of things at once comes to a conclusion, based upon a superficial view, and says the stain or the sponging caused the blister by softening the glue and loosening the veneer.

"BLISTERS" IN VENEERS.

That the water used in sponging or staining was the immediate cause of the veneer raising in a blister there can be no doubt, but it would never have raised had it been glued to the corestock. When we look at the matter calmly, and without prejudice, we will see that it is not a reasonable contention that the quantity of water used in sponging or staining could in a few minutes penetrate the veneer and glue to such an extent that the latter loosens its hold and allows the former to raise. And if it cannot do this in a few minutes it can never do it because, after a few minutes in the temperature of the average finishing room, the moisture has largely evaporated. Instead of the moisture which is still in the wood penetrating deeper to affect the glue, it is being drawn out and vaporized by the atmosphere. I have heard the argument frequently advanced that if veneered work has an inherent weakness, then everything possible should be done to prevent this weakness manifesting itself. Here, again, a superficial view gives this the appearance of being reasonable; and it would be a reasonable proposition if time alone could heal the defect and strengthen the weakness. But such is not the case. Time is against it, and if we do not do something to detect these defects in the early stages of the finishing process, time will reveal them for us and do it in a period when it will cost considerable to right the wrong.

CORRECT WEAKNESS IN VENEER EARLY.

If there are those who still believe sponging will injure veneered work, here are a couple of experiments for them to try: Select a piece of veneered work that you are positive is perfectly sound. Sponge this piece with water every half hour until you can pull the veneer off. By this time I think you will be ready to admit that one sponging or one coat of stain will not do any

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injury to good veneered work that will be perceptible.

The other experiment is this: Take a veneered board and a pail of water. Pour into the pail of water a sufficient quantity of stain to give it a deep color. This color will enable one to detect the distance it penetrates into the wood. Take a brush or a sponge and apply to the veneer a coat of this colored water. Put it on heavy, many times heavier than would be done in the ordinary course of staining or sponging. After it is dry sand or scrape the surface until all signs of the stain have disappeared. When this has been done it will surprise many to learn what a short distance it penetrated into the veneer. One must come to the conclusion that the primary cause of loose veneer is much deeper than this.

EXPERIMENTS IN SPONGING VENEER.

We think we have shown that no harm results from sponging veneered work, and we might enumerate a few of the advantages to be gained from this practice in the preparation of both solid and veneered work for the finish, apart from the raising of the fuzz.

Mahogany, with the exception of Cuban mahogany, is very soft and easily bruised. It is asking too much that this wood pass through all the various processes from the dry kiln to the finishing room without receiving any bruises. If nothing is done in the process of cleaning up this wood to bring these bruises back the surface will be cleaned off to a level with the bottom of the bruises, and when the stain is applied, if a water stain is used, the bruises will swell up and leave raises on the wood. If an oil stain is used these bruises will not likely manifest themselves until the finishing process has pretty far advanced, perhaps not until they have passed through the varnish room and the goods are being brought out to rub. During the weeks that the goods have been in the finishing room the expansion and contraction of the wood caused by atmospheric changes have relaxed the tension of the fibers in the bruised part, and they have endeavored to resume their normal condition, and raise higher than the surrounding fibers, owing to the others having been cut down in the scraping or sanding. Had this wood been sponged with water some time during the process of cleaning

CORRECTING DEFECTS IN MAHOGANY.

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up, these bruised parts would have been swelled out to their normal condition, and, if too high, they would have been cut off to the proper level.

In cleaning up mahogany or other soft wood that has been shaped or run through the sticker, sponging is of incalculable benefit. The rapidly revolving knives, no matter how sharp or well adjusted they may be, and the rollers through which the wood passes, are certain to make indentations in the softer woods. Unless something is done during the process of cleaning up to bring these indentations back, they will show up after the goods are finished.

BRINGING BACK INDENTATIONS.

It is not an uncommon thing to see O. G. drawers and other shaped work, such as rolls of beds and mirror frames that have been veneered, showing up these regular indentations. These marks are not so pronounced if the body of the article in question is made of some hardwood, such as birch or maple, because these woods do not bruise easily. But a great deal of veneering is done on whitewood and basswood—woods that are very soft; and, under the mistaken idea that the veneer will cover up all defects, no effort is made to clean up the core before the veneer is laid.

In order that goods may be given a good finish at a minimum cost in the finishing room, it is imperative that everything be right when the goods reach that department. The object of finishing is to draw out and enhance the natural beauty of the article finished, and this can be accomplished only when there is some natural beauty to enhance. The same force or power that reveals and enhances the natural beauties of the wood will show up with equal distinctness any defects that may be present. After an article is cleaned up, and ready for the finisher, no one can tell whether care has been exercised in the preparation of the corebody for the veneer. But with each succeeding application after the finishing process has commenced there is a gradual unfolding, alike of beauties and defects, and it is then that any neglect or carelessness on the part of the woodworker will manifest itself.

DEFECTS SHOW UP EQUALLY WITH BEAUTIES.

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CHAPTER XVI.

PREPARATION OF CROTCH VENEERS.

CONSIDERABLE trouble is experienced at times with crotch veneer that has chipped during the cutting. Little particles of the veneer are broken out, but it is not advisable to scrape the whole surface down to a level with the holes because that would make the veneer too thin, and perhaps result in scraping through in places. Various methods of filling these holes have been tried such as burning shellac gum into them. But this plan is not satisfactory because burnt shellac is not sufficiently transparent. A number of wood finishing supply houses have placed on the market a transparent cement by the aid of which these defects in crotch veneer, together with all kinds of chips and bruises, may be repaired so perfectly that the most careful search will fail to find them after the goods are finished.

HOW TO FILL HOLES IN THE CROTCH VENEER.

The tools necessary for the work are a spirit lamp and a knife. Any narrow piece of steel or iron that is heavy enough to hold heat for a minute will answer the purpose of the knife. The best tool for the purpose is made by grinding the edges of a putty knife until the end of the blade is about three-eighths of an inch wide. It is necessary that a spirit or alcohol flame be used, as any other flame will discolor and destroy the transparency of the cement.

DO REPAIR WORK IN THE CABINET ROOM.

The proper place to do the cementing is in the cabinet room at the time that the wood is being cleaned up. The earlier the defect is discovered and repaired the better. The first thing to do is stain the hole with some of the stain in which the goods are to be finished. Stain will not "take" over this cement, and as the latter is transparent, it is necessary to stain the cavity before filling, in order that it may have the proper color after it is finished. Stain a wide margin around the cavity to prevent cement coming in contact with the white wood, when putting it in or sanding afterward.

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If the cavity to be filled is not large, the knife should be heated over the flame until sufficiently hot to melt the cement when held to it, and when enough has been melted to fill the hole it should be pressed in with the knife. If possible, take up a sufficient quantity the first time to fill the hole, because if the first lot becomes hard before the second lot is put in, a perfect union between the two lots may not take place, and the last lot may chip off.

If the hole is large a better way would be to hold the lamp on its side and bring the cement in direct contact with the flame and as the cement melts allow it to drop into the cavity until the latter is full. When cooling, but while yet in a soft, pliable condition, the cement should be pressed firmly into the cavity to insure it obtaining a firm hold of the wood, and to destroy any air bubbles that may have formed. When the cement is hard, cut off the surplus with a sharp chisel and sandpaper.

WHEN DEFECT ESCAPES EYE OF CABINET MAN.

But it sometimes happens that defects of this kind escape the attention of the man cleaning up the wood, and are not detected until they reach the finishing room and receive a coat of stain. When that happens, the better way would be to allow the goods to proceed until they have received a coat of varnish. If an effort were made to remedy the defect at this stage, it might result in making matters worse by cutting or sanding into the stain. If it is delayed until a coat of varnish has been applied it may be proceeded with without danger from this source. But when sanding over the varnish, a little linseed oil or benzine should be used to prevent the sandpaper burning or scratching the varnish.

A good alcohol lamp may be made from an ordinary machine oil can. Cut off the end of the spout leaving only about one and one-half inch of the larger end. Ordinary cotton twine may be folded up to make a wick, if nothing better is at hand.

When using the lamp do not allow the knife or the cement to come in contact with the wick, because if the wick becomes dirty it will smoke and smudge the cement and destroy its clearness.

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CHAPTER XVII.

DIPPING OR TANKING STAINS.

DIPPING or tanking stains, that is, immersing the material to be colored, is found to be expedient in many lines of manufacture, such as in factories where small parts are used, or where small pieces are manufactured, toys, checkers, piano and typewriter keys, handles, and all similar parts. These can be colored much more uniformly and cheaper when subjected to the dipping process.

STAINING BY DIPPING IS RAPID METHOD.

Considerable uniformity can be maintained provided certain basic facts relative to the material are employed. Spraying will produce the same effect until the stain is completely consumed; this cannot be said for a dipping stain. The dipping method is an economical method as far as labor is concerned, and a speedy method where the articles dipped are not too large. The one difficulty, and the one question that is sought to be cared for, are the methods to keep the stain of uniform strength throughout the manipulation, so that the last piece dipped will have the same color as the first piece.

It is a peculiar fact that one color, that is, one color material, may have a greater affinity for the wood than another. Thus it is this particular component is exhausted much quicker than some of the others, so that after a dipping stain has been used for some time, the shade is so gradually changed it is not noticed at the time, but when the first piece is compared with the last piece there is quite an appreciable difference. In many things that are dipped, such as stepladders, handles, toys, this may not make much difference, but in furniture it should not be the case, and, by the simple methods which will be given, can be avoided. Supposing a man were dipping children's furniture, and a hundred sets were to be run through. Naturally the little table would go first, then possibly the chairs next. It might so happen that a fair degree of uniformity

COLORS HAVE VARYING AFFINITIES FOR WOODS.

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would result, but unless the stain is kept up to standard some parts of that set are very apt to be lighter, that is, of a lighter shade than those dipped at first.

Another peculiarity of dipping stains is the fact that on hardwood the color will exhaust proportionately quicker than on soft woods. This, because of the fact that on the hard woods less vehicle is absorbed than on the soft wood. In dipping a soft wood the vehicle penetrates farther but leaves color particles more on the outside. While it is not absolutely correct to say "color particles," it is nevertheless the case, and of interest to note that the moisture precedes the color.

LESS VEHICLE ABSORBED ON HARDWOOD.

Dipping stains are usually made of oil, or water as a vehicle. By oils is meant turpentine, benzoles, and the various naphthas. To those not acquainted with the dipping proposition it might be well to say that it is a quick way and a very good way. The care taken is proportionate to the quality of the material manufactured. Cheap goods are simply dipped and passed along on a draining board which permits the excess stain to run back into the tank. Better goods should be wiped clean to avoid runs. It ofttimes may be necessary to make a dipping stain a trifle stronger than where it is applied with a brush. It will be seen usually that this is necessary because the stain is not worked in.

If it is a water stain, many may have misgivings as to the effect on veneers and glue joints. These can be dispelled easily because the article is simply immersed, and immediately withdrawn, and in these cases, a hot dipping stain, when made of water, is better than a cold dipping stain. First, it penetrates more readily, and second, it dries quicker. The wiping off on hardwood especially is to be recommended to overcome any possible air cells or patches that might not be covered when the immersion is done quickly. Thus it would tend to make a uniform job. It must be remembered, however, that a stain applied cold will not give as dark a color as one that is applied hot, for it is readily understood that the hot mixture penetrates deeper and in consequence deposits more color.

DIPPING STAIN SHOULD BE STRONGER THAN BRUSHING.

In a water stain it does not matter what shade or what kind of wood is to be dipped, it is merely a case of

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establishing the strength in accordance with the method to be employed; that is, whether it is going to be used cold or whether it is to be kept warm by a steam coil or a steam jet. One thing is certain, a stain should be kept at uniform temperature so that the penetration is uniform.

Again, the material to be dipped should be of uniform temperature. Raw material should not be stored in a cold room and then brought in to be dipped. There would be some disappointment, especially on hardwood, if this were undertaken. A steam jet in a large vat works satisfactorily but not so well in a small vat. There is a certain amount of condensation which adds materially to the amount of water. A certain amount of water follows steam, and if the pressure is low, there is apt to be quite an amount of water added to that in the vat. The diminishing of the water by the dipping process is carried on in a direct ratio with the color materials, and these can be kept up to standard as we will shortly see.

STAIN SHOULD BE KEPT EVEN IN TEMPERATURE.

Consider an oil stain. For example a golden oak, the color of which depends largely upon asphaltum varnish, oil yellow and oil black. It will be noticed that the yellow on many woods gradually will become less noticeable; in short, it is exhausted quicker than either the black or the asphaltum component. If it is desired to keep the oil stain warm it can be done by means of a steam coil, and on good furniture it is more necessary to wipe than on cheaper materials. Where it is to be wiped clean the stain should be stronger or the immersion longer. Manufacturers of asphaltum varnish of late have been selecting their material so that a richer and more golden color is obtained than heretofore. It is sold as asphaltum varnish for making golden oak stain. Some call it standardized asphaltum, which name covers the two requisites of the material for producing stains: First, the color, and secondly, a uniformity of strength, so that a given amount of asphaltum will always have the same color value as the preceding lot. The maker of stains has simply to specify what he wishes this asphaltum for, and he can readily find it in the market.

THE USE OF ASPHALTUM.

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Now that the two colors, here referred to, have doubled and trebled in price, it might be of financial interest to those using golden oak stain to investigate this method of producing it. Those who are making the grayish cast of golden oak will find that the asphaltum with the black will give them the desired results. Any innovation in a method meets with a certain amount of opposition by those who have been following a beaten path. All kinds of criticisms are heaped upon the idea. The spraying machine is an example. No new method ever received such a chilly reception as did that. Unquestionably, if one would suggest to a factory which never did any dipping, to dip its work, the same reception would be in store for the method.

SOME OPPOSE DIPPING METHODS.

It is not claimed that everything and anything can be dipped. Common sense tells us that. But there are hundreds of small pieces manufactured that can be subjected to the dipping process at quite a saving of time and labor, with probably better results than where an attempt is made to do the staining with a brush. Brushes cost money these days.

Undoubtedly fault will be found at once as to the possibility of keeping a general uniformity of color, but this is easily handled in the following manner. When the strength has been ascertained, the vat prepared, either for oil or water stain, and all the tests have proven that the first immersion gives the desired color, the standard is then kept by proceeding as follows:

TESTING FOR UNIFORM COLOR.

A cylindrical vat is filled with the original liquid, or a large test tube would make a very practical container, securely corked and labeled as the standard. Strong solutions of known strength are prepared of the different components of the stain. Then we proceed to dip, and after the process is continued a sample is removed from the vat and compared with the original. If it has fallen off at all, it will be noticed immediately when held up to the light. A delicate test is to watch the effect of a few drops of this material on a clean blotter. It will be noticed that as it spreads on a blotter the different colors will form a circle, the stronger color penetrating out into the blotter farther than the

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weaker color. These rings will tell you at once by comparison which color is exhausted the most.

From these comparative tests we realize that the stain is not up to the original test. Although the work being dipped may not yet manifest the discrepancy, the stain having run down, the balance left in the vat can be brought up to standard. The sample taken from the vat is carefully measured out in a cylinder, and the quantity in the tank figured up. The tanks are usually square, and by ascertaining the amount of cubic inches, dividing this by the amount of cubic inches in the gallon, the number of gallons in the tank is established. Granted that our cylinder holds a pint, this is brought up to strength by adding from our standard solution stock enough of each color so that by comparison with the solution in the thin tube the color is identical. Then if the amount has been carefully kept track of, that is, the amount of the solution added to the pint, and is multiplied by eight, there being eight pints to the gallon, and this multiplied by the number of gallons in the tank, the amount of stock solutions to be added is given. This added to the liquid in the vat will bring up the stain to its original strength.

STAIN NOT UP TO ORIGINAL TEST.

This is not a long procedure, nor is it a difficult one; in fact, it is an interesting problem for the foreman finisher. The same proposition will confront him when he comes to increase the amount of stain in the vat. Take a vat of 25 gallons; when it runs down so that it no longer covers the materials that are to be dipped, the quantity of stain will have to be increased. It might be an easy matter to simply make up another batch of stain and fill the vat to the required depth; but when a stain has been used so long that the quantity is reduced—where the tank needs filling—it is apt to fall below par, and before adding new stain to it, it first should be brought up to strength. I know of no stain that becomes stronger in the dipping process, but should such a proposition arise, it is an easy matter to reduce it by the addition of more vehicle.

TEST IS AN INTERESTING PROBLEM.

An oil stain containing much naphtha is of more or less danger owing to its vapors, and an open blaze should not be permitted in close proximity, nor should

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an open flame be on any floor below a dipping vat where oil stains are employed. Naphtha vapors are heavier than air and follow the floor rather than rise to the ceiling. Naphtha vapor will run along the floor, following a current of air down an elevator shaft and to a fire room, and in this manner a sudden blaze may be caused. Good circulation is necessary, and should be of such strength that the vapor is brought out of doors in the shortest possible time. When the vat is not in use, provision should be made to draw off the oil stain into air-tight cans, for if allowed to stand any length of time, enough of the light oils may evaporate to cause a material change of color.

DANGER OF OIL STAINS WITH NAPHTHA.

Small pieces for staining can be handled in baskets or cages that can be closed, made of wire, the mesh just small enough so that the pieces will not fall through. This wire cage is immersed in the tank, and worked up and down, so that the liquid penetrates and touched all pieces. It is then pulled up and swung over onto the dripping board which leads back to the tank. Where the stain is hot, it will be found the pieces are practically dry in a few minutes. The basket is opened and the contents dumped onto the upper end of the dripping board from which it readily can be removed in a few minutes, without the dye being affected in any way. This dripping board acts as a drying board, from which the stained pieces can be shoved into carts for the next operation. In case of caster wheels, or small parts that are to receive a polish, directions will be found in this book for producing an inexpensive polish by tumbling them.

STAINING BY IMMERSION.

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CHAPTER XVIII.

IMPORTANT FUNCTION OF FILLER.

AFTER the preparation of the wood, through the sanding and sponging process, the next step is Filling. Proper filling of the wood is as important as any one of the details that go to make the finish.

FILLING AN IMPORTANT PROCESS.

It might be said that all woods are filled, modified, however, by stating some are filled with a liquid filler, some with an absolutely transparent filler, and others with a paste filler. Woods like gum and Circassian walnut come in the class of transparent fillers, by which is meant oil, shellac, or one of the many modern products of the varnish factory. Before the discovery of a filler, repeated coats of drying oil were rubbed into the wood.

Then came the era of shellac. The finisher should remember that while shellac makes a very admirable first coat finish, it should always be applied thin, as it does not form the best adhesion either to the wood or the subsequent coats of varnish.

When shellacs are used with the idea of constituting a filler coat, they should be applied thin, two thin coats being preferred to one heavier coat, and should be sanded smooth. The wood then will be ready for its subsequent finish. On porous woods, it is better to use a paste filler, preferably made from a floated silex base, than either a shellac or liquid filler. The object is to fill the pores with material that will neither expand nor contract through the different temperatures, or atmospheric conditions.

PASTE FILLER FOR POROUS WOODS.

Here let it be understood that experience has taught us that any vegetable, such as the various starches, which have been used in years gone by, is a mighty poor filler at the best. Whiting, China clay, resins, lime or flour should not be considered up-to-date materials. For let it be understood that a good filler is made up of something that neither shrinks nor absorbs

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any of the vehicle that may be used to spread it and hold it to place. It must be impervious to water. Temperature should have little or no effect. It must be a material heavy enough in specific gravity to obviate the carrying with it of air cells into the crevices or pores of the wood. These air cells will afterward permit the settling of the filler. The entire finishing process will be completed before this will manifest itself. To the writer's mind, there is nothing that will take the place of floated silex.

GOOD FILLER MUST BE ONE IMPERVIOUS TO WATER.

The addition of color material should be only of such quantity as absolutely necessary to produce the shade desired, and in such cases colors ground in oil are preferable, as the grinding process intimately mixes the oil with the color particles of the pigment employed, and in such case reduces the bulk of the color to the minimum. Compactness of a filler is the desired object.

Liquid fillers, such as those made up of oils and resins, into which have been ground various earthy products, are on the market, and usually found in paint stores, either as natural or colored, according to the woods and finishes for which they are desired. They are neither a liquid filler nor a paste filler, but might be said to be the paste filler thinned, ready for the brush, when stirred.

These fillers are adapted to many cases of finishing, where the artisan has not the material at hand with which to prepare his own filler. In the larger plants it is necessary for the foreman to thoroughly understand the coloring and preparation of the filler for the particular finish that is being produced.

FOREMAN MUST UNDERSTAND FILLERS.

In this treatise, with each stain formula given there will be found an indication of how to color the filler for each particular finish, which, together with this general outline of fillers, will enable the reader to comprehend and understand the procedure he should follow.

That the filler plays a large part in the production of the color effect, especially in the oaks, is known to every finisher. Filler must be in harmony with the stain, but if it is too radical in shade, it becomes freakish and, when the wood mellows down, shows that it

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is not a part of the staining operation, but it is apparent it is applied to the wood in solid form and, in short, does not affiliate itself with the general desired results.

In such finishes as antique oak, Flemish, bog, malachite green, forest green, cathedral, Early English, Antwerp, Belgium, baronial, Dutch brown, English oak, golden oak, tobacco brown, silver oak, gray oak, Kaiser grey, oriental, sixteenth century, drift wood and others, the filler plays an important part in the results.

FILLER MUST BE IN HARMONY WITH STAIN

Each and every one is produced to harmonize in color effect with the general style of the finish. It is not uncommon, especially in matching products of other finishers, to have the correct match as far as the stain is concerned, only to ruin all the efforts by making the wrong colored filler. It is well for the artisan to have a small magnifying glass with which to thoroughly inspect the filler of the sample that he is trying to match.

Under the chapter Matchings, and in the procedure there given, will be found valuable hints on how to recognize the color in a sample of finish brought in for matching.

It will easily be seen that it is absolutely essential to have a knowledge of the procedure necessary for the production of a good, reliable filler. Leaving aside the question whether it is best from a financial standpoint to buy the silex filler in paste form or to buy it in the dry form, the artisan should know how to proceed to prepare his filler for any particular style of finish.

USE OF SILEX IN FILLERS.

In cases where the paste filler is at hand, as stated before, stir in colors ground in oil, such as recommended and such as were found to produce the desired shade of filler. When the dry silex is to be used, stir into the silex boiled oil and turpentine of sufficient quantity to make a homogeneous paste of the consistency of a very heavy paint. Then the color is thinned, generally using nothing but turpentine. When this is so you can pour it out of the can, stir it into the paste filler until the same becomes of a uniform color, a homogeneous mass, when it is ready for thinning with naphtha.

Filler should be stirred continually when being applied. It should be rubbed crosswise of the pores.

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When filler in drying settles in the pores it is an indication it has been thinned too much. If filler lifts, when wiping off, it is an indication that not sufficient binder is in the mixture. In that case the addition of a half pint of japan to the gallon of filler will overcome the difficulty. In the preparation of filler for such finishes as Antwerp, bog oak, Flemish, Belgium, Early English, a black filler only is employed. This requires nothing more than drop black, ground in oil. Drop black is much superior to lampblack, and it is only necessary to use quantity required to give the silex a black color.

PREPARATION OF FILLERS.

In such finishes as baronial, cathedral, Dutch brown and sixteenth century, the fillers are usually colored with Van Dyke brown. The same effects can be produced, however, by using burnt umber and toning it down with black, or black and an orange, but the most economical that we have is a Van Dyke.

It will thus be seen that the majority of fillers on the oaks are made with black or brown, the only difference being that the strength of color varies. In the greens, chrome green is employed. In the case of forest green, equal parts of chrome green and drop black are used, and in some cases a small percentage of brown. In the olive oak, which is another finish that is used more by chair manufacturers and fixture concerns, the green is produced by the stain, but the filler is black.

In general, the use of silex, colored to match the style of finish, and thinned with naphtha, is a general procedure. Where large quantities of filler are made and used, a saving can be made by the employment of mineral turpentine, which costs about one-third as much as regular turpentine. Where this is employed it is well to use about four ounces of cheap rosin varnish so as to keep up the binding qualities that would be had where boiled oil and regular turpentine were employed.

MINERAL TURPENTINE ECONOMICAL.

Silex might be likened to powdered glass. Spread over the surface and into the pores by means of the liquid vehicle, which has just sufficient adhesiveness to hold the filler in place, there can be no shrinkage in the material. When the work is cleaned up, the excess moisture removed and the filler thoroughly dried, it

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holds its place and form, and the subsequent finish remains where it is put.

The present style of the many so-called Mission finishes calls for a light colored filler, especially in oaks, the pores of which have been extended by the wood having been first sponged, sanded and the pores opened with a picking brush. The effects produced by giving the fillers various shades ranging from absolute white through all the grays, greens and browns, are in many cases very pleasing to the eye. The gray oaks lend themselves particularly well for this sort of treatment. These finishes are known under many different names, but are usually finished in waxes. The best procedure is to use a strong water stain which will give the color deep enough so that when the lighter filler is used there will be some difference between the stained wood and the color of the filler. The effect is striking; a good clean job will not permit the filler to be smeared over the wood. Where an absolute white filler is desired, and where the wax is to be the finish, it is well to give the work a very thin coat of shellac, and then mix carbonate of zinc, known to the trade as zinc white, with wax, and rub it across the pores until they are thoroughly filled. Let this work stand for 24 hours, then apply second coat of wax, bringing it to a polish.

MISSION FINISHES DEMAND LIGHT FILLERS.

Where a gray filler is desired this same procedure can be followed, merely coloring the white with dried drop black.

Filler should be applied only after the wood has been thoroughly prepared, sandpapered, cleaned up and dusted. Emphasis to be placed upon the "cleaned up," which means that no finger marks from previous handling should be allowed to remain. It should be dusted so that all the fine particles arising from the sanding are removed before the filler is applied.

APPLY FILLER AFTER WOOD IS "CLEANED UP."

The filler should be of the consistency of a varnish, applied with a good brush, rubbed well into the grain and pores of the wood. When the filler is fairly well set, which is when it begins to show flat, rub it into the wood with a pad, always rubbing across the grain.

For spindles and long turnings have a long strip of leather to draw back and forth around the work.

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Fill only as much surface at a time as you can wipe off before it sets too hard to rub off without rolling up. Wipe off with tow or excelsior or rags all the filler except that which is in the grain or pores, and be careful to have all the grain and pores level, full of the filler, because upon that feature the success of your work depends. All rubbing and wiping must be done across the grain. Give the filler all the time to dry you can, but never less than 36 hours, especially when the grain is rather open. When dry go over it lightly with No. 0 sandpaper to take off every particle of filler left on the surface. The cleaner you wipe off the filler the cleaner the finished job will be.

FINISHING SHOULD BE DONE ACROSS GRAIN.

If you want to do high grade work it is well to examine the filler surface with a magnifying glass to see if the pores are well filled and no pinholes visible. If there are such defects, it is best to go over the surface with a filler a second time, but have it of thinner consistency than at first, and repeat the operation of rubbing, wiping off and sandpapering.

An exception to the general rule of filling, and it might be said of staining, is that of the production of golden oak, as employed by many of the larger furniture factories, showcase and school equipment companies. The stain is produced by the use of asphaltum varnish, augmented by the addition of oil soluble black and yellow as will be found in the chapter on Stain Formulas.

This stain is spread over the sanded and dusted work in such an amount as to leave an almost black-brown coating, which is permitted to set from 15 to 30 minutes, according to the amount of drier that the stain contains. It should not be permitted to dry, but just before it sets a natural filler, that is, a plain uncolored silex filler, is worked across the grain of the wood. It gradually lifts the excess stain and gradually with the filler is worked into the pores. This process is continued until the filler is about to set. When it is cleaned off the filler is colored, the pores and grain are thoroughly filled, and golden oak is stained and filled with an oil stain with this procedure.

After the cleaning process is accomplished a thin

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coat of shellac is applied, and the finishing coats are given.

Bent wood, such as chair backs, seats, etc., which have been subjected to the steaming process, may give trouble which would manifest itself in the filler coat. This is due to the fact that wood treated in this manner, when not properly stored, is apt to re-absorb moisture, and, after the filler is applied, permit a settling of this filler, through the fact that as the moisture leaves the work the filler follows down into the wood.

BENT WOOD GIVES SOME TROUBLE IN FINISHING.

When difficulty like this manifests itself the first thing to do is to look up the history of the stock, and the condition in which it is received. Take a suspected sample, see that it is thoroughly dry, and put it through the regular process. This will prove whether or not moisture has caused the difficulty with the filler.

The universal method for finishing cedar chests does not call for a filler. But there seems to be a demand for a filler that will take care of the rough spots in the knotty portions of the wood. The desire principally is to get one that will harmonize with the shade. For this purpose Van Dyke brown and rose pink will give the best colors with which to color the natural filler. Where bits of wood have been pulled out by rough planing, colored shellac serves nicely, and if the depressions or holes are large enough to warrant the use of shellac sticks, it is preferred to melt the shellac into the crevices. Another method would be to work into the rough spot a colored shellac, colored with Bismark brown, giving the work repeated coats until a smooth surface is obtained. Then sand this to the evenness of the regular work in the following manner:

USING SHELLAC TO FILL HOLES IN FINISHING.

Cut down the shellac with a No. 0 sandpaper and finish up by using a No. 00 sandpaper which has been dipped into light rubbing oil. This will not disturb the underlying depressions, and will give a toughness to the shellac used as a filler, which will keep it in its place, and leave it ready for the general finishing coat.

The following list will give the artisan a good idea of the colors necessary to obtain certain shades, especially in producing tints in the fillers. Undoubtedly the list given will be of additional value to the informa-

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tion already given with each formula, in which also is mentioned the filler. Produce the color first and then with it tint the filler. It is best to obtain colors ground in oil or japan. Mix these and stir into the filler. In case the dry silex is used in producing the filler it may be well to use dry colors. Stir them thoroughly into the silex and add to it the japan, boiled oil and thinner, as given elsewhere:

COMBINATIONS PRODUCE CERTAIN SHADES.

Combinations of	Products
Red and black	Brown
Lake and white	Rose
White and brown	Chestnut
White, blue and lake	Purple
Blue and lead color	Pearl
White and carmine	Pink
Indigo and lampblack	Silver Gray
White and lampblack	Lead color
Black and Venetian red	Chocolate
White and green	Bright green
Purple and white	French white
Light and dark green	Dark green
White and green	Pea green
White and emerald green	Brilliant green
Red and yellow	Orange
White and yellow	Straw color
White, blue and black	Pearl gray
White, lake and vermillion	Flesh color
Umber, white and Venetian red	Drab
White, yellow and Venetian red	Cream
Red, blue and black	Olive
Yellow, white and a little Venetian red	Buff

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CHAPTER XIX.

THE MAKING AND USING OF FILLER.

THAT which is known as filler in the finishing room is a paste used for the purpose of filling the pores of the wood to be finished. The object of filling these pores is to prevent the varnish sinking away and enable it to flow out smooth and make an even surface. Fillers are made in various ways, of various ingredients to suit the different kinds of wood on which they may be used. But there are three ingredients which enter into all fillers and which form the base for all the others. These three ingredients are: Pigment, oil and drier. The best known pigment for filler today is ground silex.

INGREDIENTS FOR FILLERS ARE THREE.

There are various other pigments in use, such as silica, silver white, and I have known good filler to be made with wheat flour and cornstarch as a pigment. It has been contended in some quarters that wheat flour and cornstarch, being vegetable products, are liable to decompose in the pores and thus destroy the finish. But I do not believe that contention to be well founded. The wood itself is a vegetable product and the oil that binds the pigment together is of the same origin. Why should one be more liable to decomposition than the other, especially as the pigment is protected by being surrounded by the oil? I have seen goods that were filled over a quarter of a century ago with a flour-cornstarch filler today showing no signs of decay in the filler.

FILLER IS DETERMINED BY WOOD.

For oak filler silica makes a good pigment and it is economical. It is much less expensive than silex and considerably lighter in weight.

For walnut and mahogany woods that are somewhat easily clouded, pure ground silex should be used as a pigment for the filler because it is more transparent, and, therefore, less liable to leave the slightest sign of a cloud. Silex is offered in various degrees of fineness, but the finer it is the better. It not only is more trans-

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parent when fine, but it is easier to use and does its work better.

Oil is the ingredient that binds the fine particles of pigment together so that when dry they form a solid substance. Boiled linseed oil is usually the kind used for this purpose, although raw linseed oil may be used with good results. A considerable quantity of linseed oil on the market today is adulterated, and care should be taken to see that only pure linseed oil is used. These adulterated oils contain quantities of fish oil or some sort of mineral oil. These adulterants prevent proper hardening of the linseed oil and the drying of the filler, and unless the filler, which is the foundation of the finish, dries and hardens thoroughly, a high class durable finish cannot be expected. Recently I was shown an inside door which was painted ten years ago with a paint mixed in adulterated oil, and it is not yet dry. In warm, humid weather the best that can be said of it is that it is dust proof. Varnish cannot harden on such a foundation, and if it is polished it will lose its brilliancy in a few days.

OIL BINDS PIGMENT SOLIDLY.

The third ingredient of which we spoke is some form of drier. Linseed oil will dry of itself, but it is too slow. Brown japan is the most popular form of drier for filler. It also helps the oil to bind the particles of pigment together. But filler in which japan is used ought not to be made very far in advance of the time it is used. All filler should be made at least 24 hours before being used, but if it is allowed to become old and stale it works sticky and hard, and will not fill the pores properly. If I were asked to set a time limit in which filler is at its best I would say between 24 hours and 10 days after it has been made. This is one of the advantages of the finisher being able to make his own filler—he can always have it in the best condition. The argument is advanced frequently that the finisher cannot successfully make his own filler because he has not the powerful machinery for grinding and mixing the ingredients. He does not need it. No matter who makes the filler, or where it is made, the pigment is ground and the oil extracted before the process of making filler commences. These are occupations by

BROWN JAPAN BEST DRIER FOR FILLER.

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themselves, separate and distinct from filler making. In addition to the proper ingredients, the only requirements for filler making are a tub, a pair of hands and the "know how." If a finishing room were using filler by the ton it might be well to use a power mixer capable of handling it in such quantities. But the quantity used in the great majority of factories can be mixed readily by hand.

"KNOW HOW" NECESSARY IN FILLER MAKING.

I have heard it said that a filler cannot do its work well and work easy. I wish to hit that right on the head, and say that a filler cannot do its work well unless it does work easy. Filler that is stiff and hard is certain to pull out of the pores when being cleaned off; while filler that will clean off easy, if otherwise properly prepared, will cut off level with the top of the pore, leaving it full. The proper kind of a filler is one that may be cleaned off easily between 20 minutes and three hours after it is applied to the wood, and will dry in 24 hours and thoroughly harden in 48 hours.

In addition to the pigment, oil and drier which form the base of all fillers, there are other ingredients added to meet the color requirements of the different woods and finishes, except when a colorless filler is desired, as these other ingredients are added for color purposes.

To make a white filler, which may be used by itself where a colorless filler is required, and which may be regarded as the base of all the colored fillers, we will give the system which we have followed for years with entire satisfaction, and which is the result of many years' careful observation and experiment:

IDEAL WHITE FILLER.

12 parts pure boiled linseed oil.
6 parts brown japan.
1 part pure turpentine.

Mix the above thoroughly, then add a sufficient amount of silex, or whatever pigment is to be used, to make a stiff dough. Allow this to stand for 24 hours, then reduce such quantity as may be needed for immediate use with benzine to the consistency required for the wood on which it is to be used.

In the above formula the turpentine is added to assist in the more complete assimilation of the oil and

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japan, and prevent the disintegrating effect which the benzine would otherwise have upon the japan.

It will be noticed that I have not given the quantity of pigment in weight. This cannot be done to advantage because the ratio of weight to measure or absorbing quality is not the same with the different pigments. But no matter what the weight of the pigment, a sufficient quantity will be required to make a stiff dough.

CARE NEEDED TO KEEP PIGMENT UNIFORM.

In order to insure uniformity a good plan would be to weigh the pigment put in the first batch of filler, and if the filler works well put the same weight in all subsequent lots. Be careful to measure the liquids accurately because on this will depend largely your success as a filler maker.

In coloring filler, if dry colors are used they will displace an equal quantity of the other pigment, so that a smaller quantity of the latter will be required than would be the case with white filler. If the colors used are ground in oil or japan, then the oil or japan, as the case may be, will displace an equal amount of its kind in the original formula, and provision should be made to meet this.

Occasionally a combination stain and filler is required for cheap goods, such as elm and ash, and one that will not require cleaning off. For this purpose reduce asphaltum with turpentine to the desired depth of color and mix into each gallon of the stain about two pounds of colorless paste filler. The paste filler for this purpose should be made of finely ground silex to insure transparency. After this stain is dry, if a coat of pigment surfacer is applied the pores will be filled perfectly, and the whole will be ready for sanding and varnishing.

REDUCING PASTE FILLER TO A LIQUID.

To reduce paste filler to the liquid state quickly, place the desired quantity of paste in the vessel in which it is to be used and pour on but a small quantity of benzine. Mix this together thoroughly, then add more benzine. It can be reduced to the required consistency much quicker this way than can be done if the full quantity of benzine is put on at the start.

The consistency to which filler should be reduced must be regulated by the porous nature of the wood on

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which it is to be used, but in any event it should be reduced to a state in which it will work freely under the brush. Filler should be put on with a medium stiff brush, giving plenty of brushing to work it well into the pores. The pores of the wood are full of air which will prevent the filler going to the bottom and getting a firm hold unless it is well brushed. Evidence of this neglect will be found in the shape of "pinholes" after the goods get a coat of varnish. Very thin filler, or cleaning the filler off while it is wet, will result in pinholes.

CONSISTENCY OF FILLER IS REGULATED BY NATURE OF WOOD.

Too frequently it happens that the edges of tops and other narrow but prominent parts of the goods are not filled as well as the larger surfaces. This is largely because these edges are usually perpendicular, and because it is more difficult to put a heavy coat of filler on a small surface than to put it on a large one. The way to overcome this difficulty is to put two or more coats on these places, allowing each coat to dry until it becomes "flat"; then put the next coat on top of it.

Much depends on the way filler is cleaned off. This should be done in such a way that the filler in the pore is disturbed as little as possible. The best thing to use for cleaning off filler is the hair-like moss used for upholstering. Of late years this has become too expensive to use for this purpose, consequently many other things have been tried in its place. Some shops use shavings, excelsior, burlap and anything that will remove this surplus filler, and yet not be expensive. We have tried all these things, and some others, and have found that sea grass, or sea moss, as it is sometimes called, is superior to any of them, and it has the additional advantage of being inexpensive.

HOW TO CLEAN OFF FILLER.

To remove filler take a handful of the grass and shake it up well to remove any hard, foreign substances, then with it rub the article across the grain. One is less liable to disturb the filler in the pores by cleaning off across the grain. After as much of the filler has been removed as possible with this grass, the balance may be cleaned off thoroughly by wiping with a cotton cloth. Sterilized cotton rags are used generally for this purpose. Avoid rags that leave lint on the work.

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Rosewood is one of the most difficult woods to fill with the ordinary wood filler. The oil in this wood will eat its way up through the filler and injure the finish unless something is done to prevent it. In the early history of what might be called our modern system of finishing, the filling of this beautiful wood was a long and costly process. Coat after coat of shellac was applied and then sanded down to the wood or scraped off until the pores were filled to a level with the surface. Shellac seemed to be the only thing that would keep in check the oil in this wood. But these several coats of shellac are not now necessary. Put on one good heavy coat of bleached shellac reduced at the rate of one and one-half pounds of gum to a gallon of spirits, using methylated spirits or grain alcohol as the solvent. Brush this well so that it will reach as deep as possible into the pores. This will seal up the fine pores through which the oil would ooze and hold it in check. After this is dry, the wood may be filled in the usual way. Do not sand the shellac before filling and do not have more oil in the filler than is absolutely necessary.

FILLING WAS FORMERLY EXPENSIVE.

When using filler, no matter on what kind of wood it is being used, keep it well stirred. Too much stress cannot be placed on the importance of this. If this is not done, the first part of the filler used will contain too much oil, and the latter part not enough because the pigment has been allowed to settle at the bottom. If the top part of such filler were used on rosewood, the consequence might be disastrous to the finish, while if the bottom were used on mahogany it certainly would be so, because in the latter case the filler, deprived of the oil, would turn gray in the pores, and give the whole work a grayish, clouded cast.

IMPORTANT TO KEEP FILLER STIRRED.

In the case of mahogany, if these conditions have all been complied with, and the pores still show a grayish cast, one must look either to the original filler, or to the method of preparing the wood to receive the filler in order to get at the cause. The filler, which is just right for mahogany that has had a coat of thin shellac before filling, is not suitable for mahogany that has not had that shellac, because it does not contain a sufficient quantity of oil for the latter. This thin coat of shellac

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seals up the fine pores in the fibers of the wood and prevents them from extracting the oil from the filler and imbibing it. This leaves the oil with the pigment and preserves the translucency of the filler, which, when dry, retains the color of the liquid state.

When filler is applied to mahogany that has not been coated with shellac the oil is drawn away from the pigment into the fibers of the wood by the force of capillary attraction and the pigment, deprived of this protection, becomes opaque and shows gray beside the brown mahogany. To counteract this, it is necessary that filler used on bare wood contain a slightly larger percentage of oil than that which is used on a shellaced surface.

SHELLAC AIDS TO PRESERVE TRANSLUCENCY OF FILLER.

I have met finishers who were of the opinion that birch-stained mahogany does not require to be filled. But birch mahogany can be finished much more cheaply if it is filled. When not filled, the extra varnish and rubbing required to produce the desired results is much more expensive than the filling would be.

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CHAPTER XX.

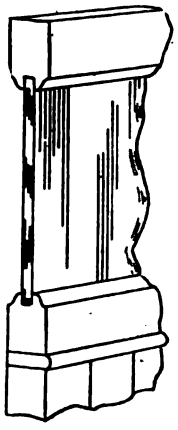
CONSTRUCTION OF A FUMING ROOM.

WITH fumed oak, as much in vogue as it is at the present time, it is almost necessary that something in the way of a fuming room or fuming box be supplied. I shall endeavor to describe three types of this sort of equipment, supplementing it with some description of the process.

TWO TYPES OF FUMING BOX.

The size of a fuming box must be left to the manufacturer and be built according to his needs. After the size of the box has been determined upon, the following methods, if followed, will produce a strictly up-to-date fuming box.

Select a place in the factory which is easily accessible to daylight, blow-pipes and steam. After setting up the framework of the size which has been decided upon for the box, inclose it with matched flooring, giving each groove or tongue a coat of thick paint and driving the joints well together. On the sides make the sash for the glass as indicated in Fig. 1. Be careful that the glass, when put into the sash, is either set in soft putty or lead in oil. The reason for this is to make everything air-tight. The door should be sectional so that it can be opened for the various sizes of furniture, as it is often the case that after a first batch has been fumed, another batch of furniture can be quickly put in this box without exhausting the ammonia gas. The doors should be made with L joints and these joints fitted with felt. The doors are then locked with a friction lock much like those that are used on an ice box. In a corner, convenient and accessible, a series of shelves should be provided, the upper one a distance from the ceiling so that it will carry a five-gallon galvanized iron can. This can should be fitted with a



DOOR SHOULD BE SECTIONAL.

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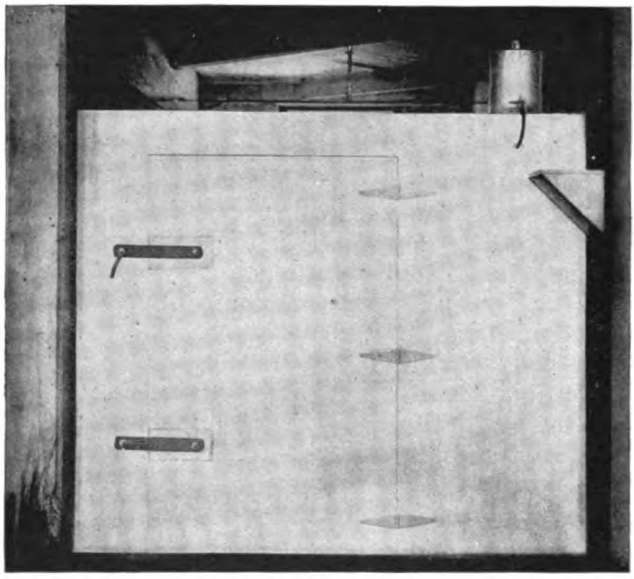
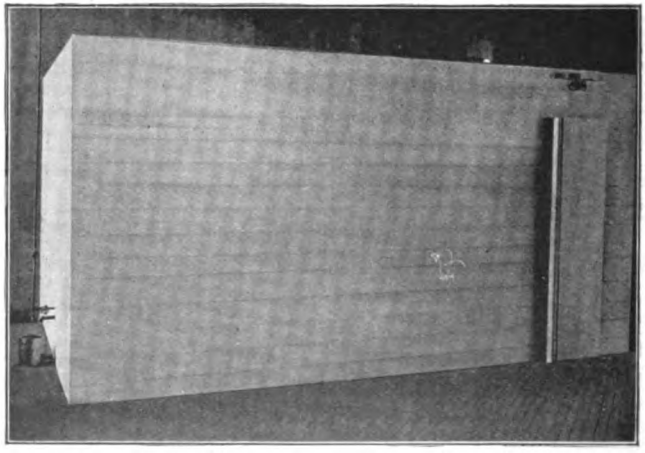


THE FRONT.



THE SIDE.

TWO VIEWS OF FUMING ROOM BUILT AFTER PLANS DESCRIBED IN FOLLOWING CHAPTER.

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faucet. The successive shelves should be supplied with half-inch deep pans, placed in such a position that when the first is filled with ammonia water it will overflow into the second and so on down until the last pan empties into usually a five or ten gallon earthen jar.

A steam coil placed in the jar will greatly facilitate the evaporation of the ammonia or, more correctly stated, the liberating of the ammonia from the water, and work an economy by reducing the amount of ammonia required. Right here is where caution must be exercised. First, the steam coil must be placed in a jar which is at least twice as large as the can. The steam coil takes up less than half of the space in the jar. This coil must then be covered with water and the steam should not be turned on until the ammonia water begins to drip from the last pan into the jar, for if the coil is not covered with water, the drippings will come down in such small quantities that they immediately will be evaporated and cause excessive moisture in the fuming box. Again, the steam must not be supplied to the coil in too great a quantity and thus create too much heat. It must be kept under control and the water maintained just below the boiling point. This can all be done by watching the process through the window. The question has been asked often whether the ammonia can be turned on before the doors are closed. Of course this is the only way it can be turned on. But it might be well to turn on the ammonia and allow the gas, in a measure, to replace the air before the doors are closed tightly.

HOW AMMONIA WATER IS LIBERATED.

Recently there appeared an article giving the details for constructing a fuming box, which is very good. Some points brought out are recommended, but the basic principle of the box as given in this chapter has not been changed sufficiently to make it necessary to incorporate any of the ideas here. One exception, however, should be noticed, because of the fact that the use of a steam coil and tank is useless and might lead to a doubt in the minds of those who wish to construct a fuming box. Therefore, it is necessary to say that the coil and jar are not placed in the fuming box to create any unnecessary moisture, which, according to the arti-

FUMING BOX CRITICIZED.

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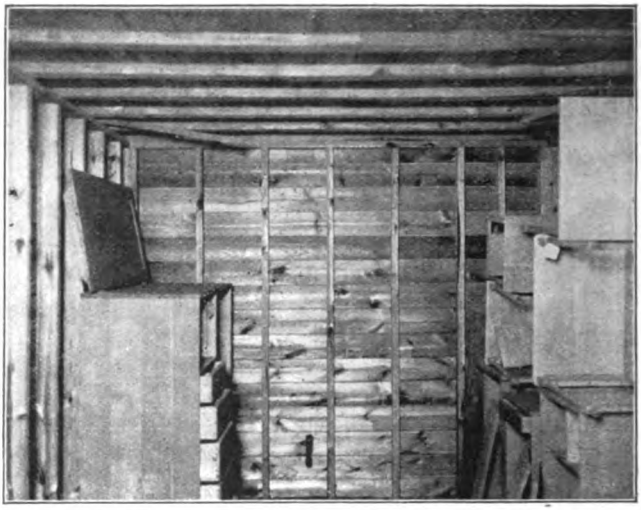

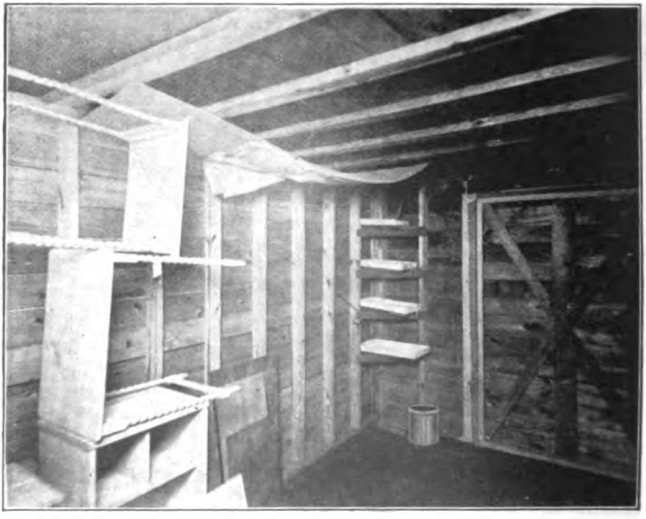

TWO VIEWS OF THE INTERIOR OF ONE FUMING ROOM BUILT AFTER THE PLAN DESCRIBED IN THIS CHAPTER.

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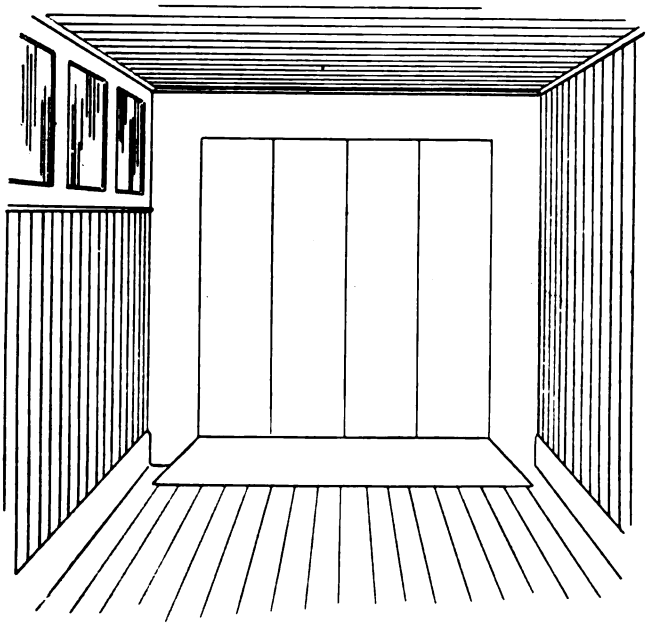
cle referred to, is employed to soften the wood. On the contrary, it is merely used to facilitate more liberation of the ammonia gas.

To repeat: The ammonia dripping down slowly from pan to pan, finally reaches the jar. There must be a jar there to receive the ammonia water as it runs from the tank over the several trays to this receptacle,

AMMONIA WATER MUST NOT TOUCH STEAM PIPE.



INTERIOR VIEW CF FUMING BOX.

which, if it is fitted with a steam coil, will heat the water present and thus help to liberate the ammonia gas. Particular attention is drawn by the writer to the fact that the steam coil must be covered with water so that the ammonia water when dropping down will not come in immediate contact with a hot steam coil and thus create steam. The entire idea is to avoid the steaming of the water and merely to raise the temperature of the water present in the tank so that the ammonia will be given off more readily. At the same time this steam coil acts as a source of heat, which heat is

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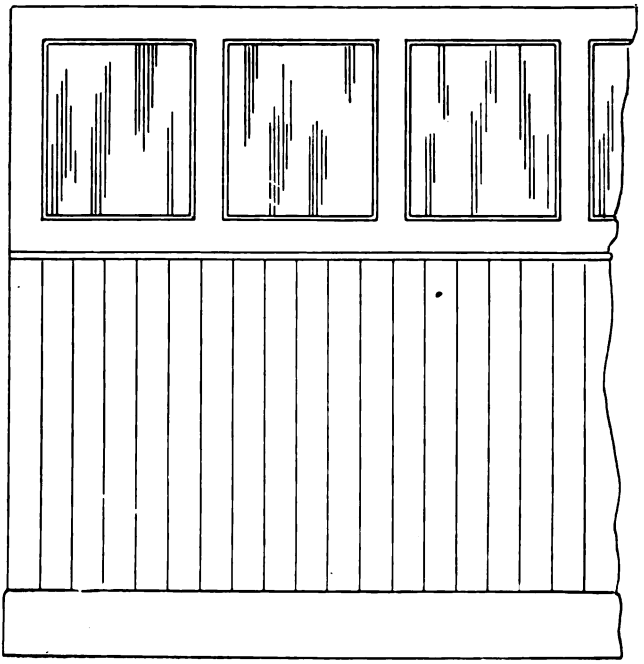
greatly desired, especially in the winter months, for raising the temperature inside the fuming box, because a warm gas will fume quicker than cold. Again, when the temperature is the same in the fuming box as on the outside, there is less condensation.

FUMING EXPEDITED BY USE OF TAN BARK EXTRACT.

The writer referred to recommends a trade article under the name of Fumine. It happens that the writer



SHOWING ARRANGEMENT OF WINDOWS

of this book originated the name of Fumine and made the original product put on the market under that name. This was nothing more than tan bark extract. It was found at that time that by the addition of tan bark extract fuming would take less time than when the wood was put in the fuming box in its natural state. Later it was found that tan bark extract was nothing more than a vehicle for tannin. Therefore, the use of Fumine, while recommended and doing the work, and while it covers all the virtues of tannin, resolves itself

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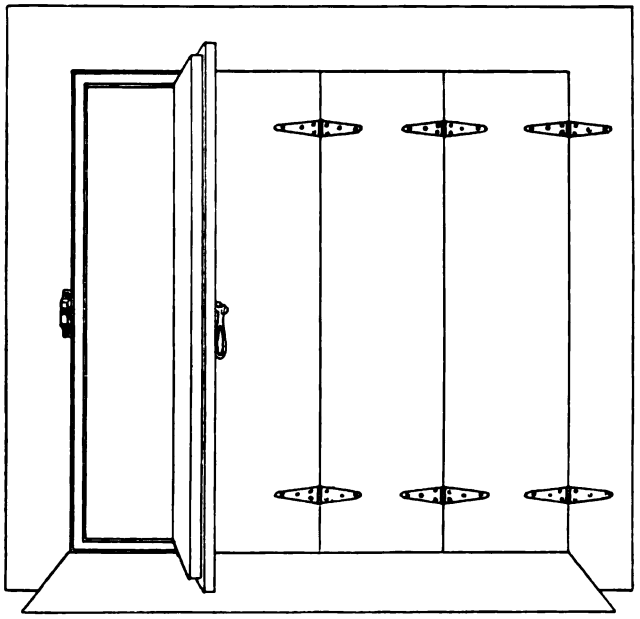
down to the use of tannic and pyrogallic acids. In covering a method for producing fumed oak it must be taken into consideration that sometimes some of the materials are not as easily obtained as others, and, therefore, the various products that can be used are given, but the one producing the best results is recommended.

USE OF TEST BOX IS RECOMMENDED.

For those who do not wish to supply their fuming



THE SECTIONAL DOORS.

chamber with windows the arrangement of an opening, called a testing box, is recommended. A sliding door of a size varying according to one's ideas, say 10x12 to 10x20 inches, is made and back of it a box is placed which again is fitted with a sliding door. When the fuming chamber is charged with gas the inner door is opened and the outer one is closed. This outer door can be made of glass, and the process can be watched. When you desire to examine results, close inner door, take out piece and test by giving it a bit of oil, rubbing and shellacing it. If desired depth is not shown, replace.

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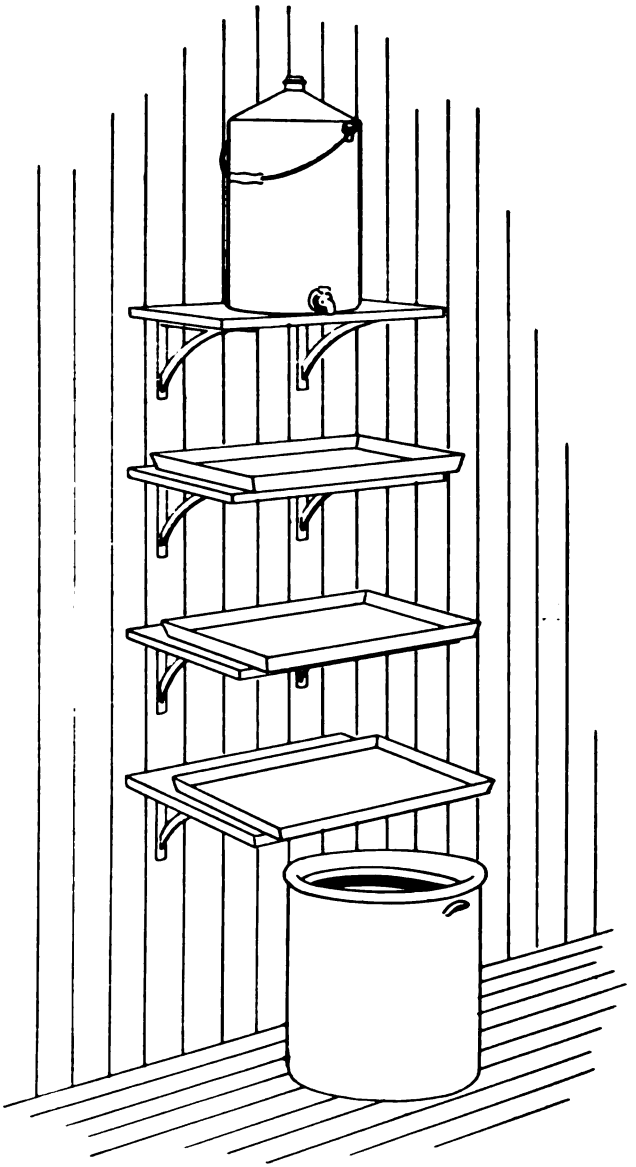

ARRANGEMENT OF AMMONIA TANK.

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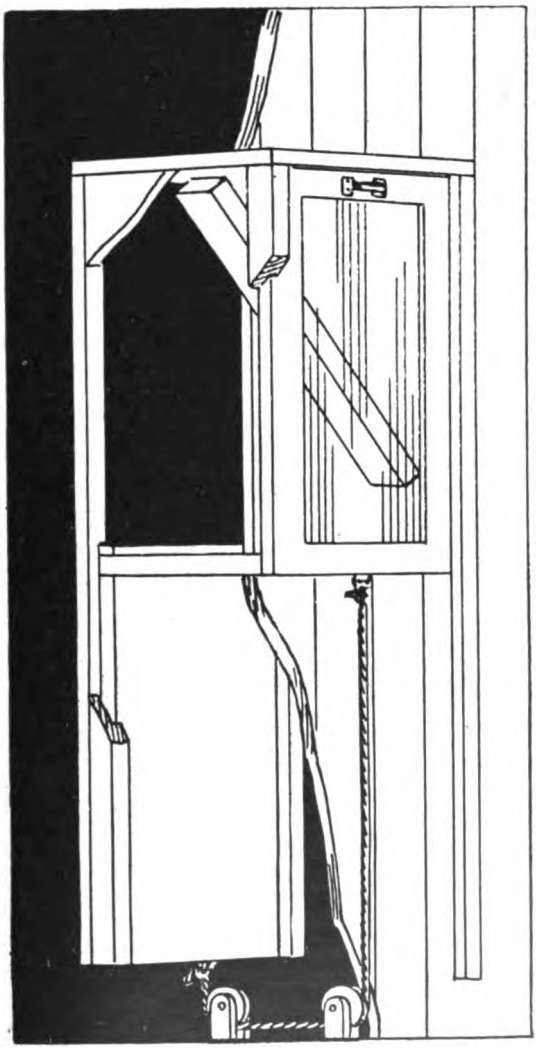

SHOWING SLIDING DOOR FOR TESTING.

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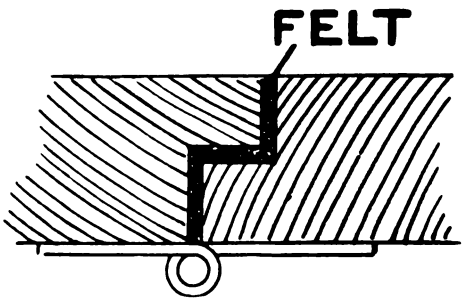
The entire interior of this chamber should be painted with the same care that you would paint a boat, and all crevices closed. In mentioning the size, it should be stated that it is not wise to build it any higher than required for the tallest piece of furniture. It costs money to fill the surplus space with gas. On the sides of the chamber, provide fastenings so that the pieces can be piled up to the ceiling without resting upon each other, much as the bed slats were arranged in an old-fashioned bed. In this way all the available space can be used. A box constructed in accordance with these directions will bring out results in the shortest possible space of time.

COLOR OF WOOD VARIED BY STRENGTH OF TAN BARK.

These results can be greatly augmented and the time reduced, when it is necessary, by coating the work with tanned bark extract, about one part to ten of water. The result, or rather color of the wood, can be varied by varying the strength of the application of this tanned bark extract. It is possible to turn out a thoroughly fumed batch in six hours by use of this extract. The question, of course, then is, which is the cheaper: to run the fuming box two or three times as long, or to coat the wood with an extract solution? It is a fact that a much deeper effect or color can be made when the extract has been applied.

Various ways have been tried for obtaining ammonia (which is a crystalline salt); by placing it on tin pans under Bunsen burners; by mixing carbonate of ammonia with unslacked lime and then moistening with water, etc.; by using the anhydrous ammonia, and, lastly, by employing aqua ammonia or water of ammonia. Anhydrous ammonia is the gas which has been liquified by compression and will expand into gas again as soon as the pressure is released.

HOW TO OBTAIN AMMONIA.



SHOWING JOINTS FILLED WITH FELT.

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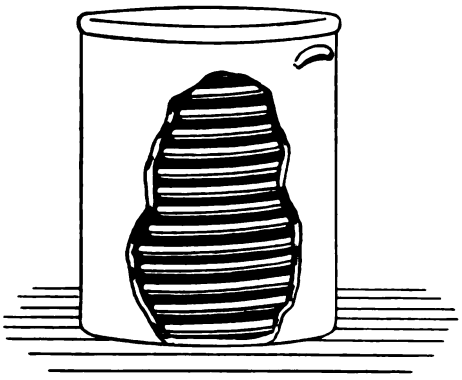
A cylinder of 100 pounds contains 100 per cent of absolute ammonia and requires more careful attention than aqua ammonia, which is a distilled water that has absorbed a large volume of ammonia gas by its own affinity and not under pressure. The ammonia in the aqua ammonia can be driven off easily by heat until nothing but the pure water remains, and this can be done by the steam coil arrangement and the agitation afforded by the dripping from pan to pan.



JAR FILLED WITH COILS.

A number of furniture factories at Rockford, Ill., have installed fuming boxes which exhibit several ingenious and interesting features.

A PRACTICAL FUMING BOX.

The room shown in the accompanying plan is that in the factory of the Union Furniture Company, of which P. A. Peterson is president. It is 10 feet square, eight feet high, and is located on the top floor of the building against one of the exterior walls. This location was determined in order to secure ventilation through the roof and into the fuming box through a window opening from the exterior of the building for quickly cleaning the box of the ammonia fumes after the fuming was completed. Aside from requiring a greater length of ventilation pipe, a location on any other floor would be as satisfactory, provided there were a window opening from the outside or other means by which to secure a circulation of air and quickly clear the box of ammonia fumes without letting them into other parts of the factory.

Both the dimensions of the box and its location have been practically adopted as standard in a number of Rockford factories. While the size permits of fuming

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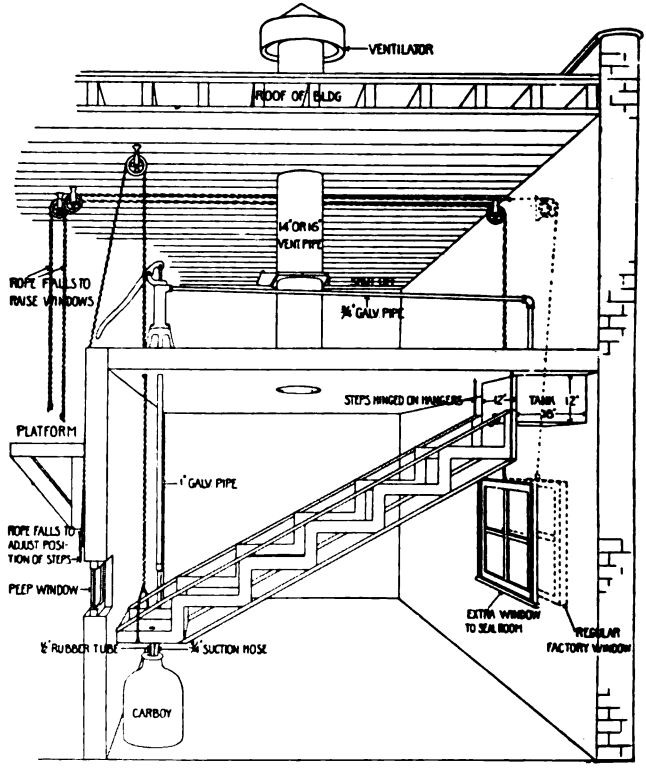
only from 25 to 34 pieces at a time, buffets, china closets, desks, etc., it has been found ample under ordinary circumstances, with the very decided advantage that a larger room requires more than a single carboy of ammonia, or a rehandling of the ammonia, and hence a longer time for the fuming process.

HOW ROCKFORD FUMING BOX IS MADE.

The box itself should be built of matched stock with



THE ROCKFORD TYPE OF FUMING BOX

IS BUILT OF MATCHED STOCK.

the finished side in. The openings in the wall are one in the top for the ventilation pipe, a door (in this case about 3x7 feet), a small sealed window located so as to place the ammonia trays in view from the outside of the box, and a sliding window located in juxtaposition with the lower sash of the window in the side wall of

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factory building. The small peep window is sealed all around and the door and sliding window fit closely and are provided with rubber strips, similar to weather strips, in order to make them air-tight when closed. The inside of the box is lined throughout, except at the ventilator and window openings, with sheet tin soldered together in the same manner as tin roofing, and correspondingly air and water tight.

PLAN FOR HANDLING THE AMMONIA.

The arrangement of the apparatus for handling the aqua ammonia and securing a dissemination of the ammonia fumes is shown in the accompanying cross section and elevation of one side of the fuming box. It occupies a space 12 inches wide across one side of the box. A tank 12x18 inches and 12 inches deep, large enough to hold the contents of a carboy of aqua ammonia, is placed in an upper corner of the box. The carboy containing the ammonia is placed in the lower corner. When the goods to be fumed have been placed in the box and both window and door tightly sealed, the ammonia is pumped by a small hand pump from the carboy into the tank. From the tank it runs through a valve and down a series of steps and back to the carboy, when it is ready for use again. The tank and steps are made of galvanized iron and the steps have three-inch sides and are braced, as shown in the sketch. In previous plans, a series of trays which overflowed, one into the other, were used in place of the steps. The valve in the top reservoir is used in both instances to control the rate of flow of the ammonia water.

FREE ESCAPE OF AMMONIA IS NECESSARY.

The number of steps shown in the sketch is not necessarily the exact number used, as the drawing is not made to scale. The object, of course, is to have enough of them to give a large surface of water from which the ammonia gas can escape, and also to give enough motion to the water to hasten the separation of the gas from it. As the fuming box is sealed, and the air free from ammonia gas, when the water starts to flow, gas is taken up readily at first. As the box becomes filled with ammonia, the gas escapes from the water less easily, and it is an advantage to have the ammonia water flow slower. The steps are hinged at

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the top and may be raised or lowered by a rope fall which supports them at the bottom and operates from the outside of the box through a small hole in the top. For this purpose a pulley is placed on one of the supporting joists of the roof, as indicated in the diagram. The same arrangement is used for raising the two windows when it is desired to clear the box of ammonia fumes. As soon as the windows are opened, the shut-off in the ventilator pipe is also opened and the air sweeps in and through the box, quickly emptying it of ammonia fumes and making it possible to remove the goods from the box without discomfort.

OBJECTIONABLE PEATURES REMOVED.

With the arrangement for pumping the ammonia water from the carboy to the tank, the handling of ammonia is relieved of most of its objectionable features. Some difficulty was encountered in devising a pump which was not affected in any of its parts by the ammonia. The pump used is made of iron and steel especially for the purpose.

About two minutes' work suffices to pump the ammonia from the carboy into the tank. It is usually the practice to place the goods to be fumed in the box at night and in the morning they can be removed. The fuming, however, can be completed in less time when necessary. Twelve to 18 fumings can be made with a single carboy of ammonia, though the later fumings, when the water is more nearly free from ammonia gas, require a longer time.

SIMPLE FORM OF CANVAS FUMING BOX.

It may not be possible in every case to construct as elaborate a fuming room as has already been described. It certainly is not at all probable such an equipment can be introduced in the manual training schools. But here is a simple form of canvas fuming box which will do its work.

Out of 2x2 material set up a frame-work, according to the size of the box desired, and cover with unbleached cotton, the weight of this to be determined by the size of the box. When the four walls are set up and screwed together, put between the joints pieces of felt or some heavy material previously saturated with silicate of soda (liquid glass) which can be purchased at about 40 to 50 cents per gallon. When the

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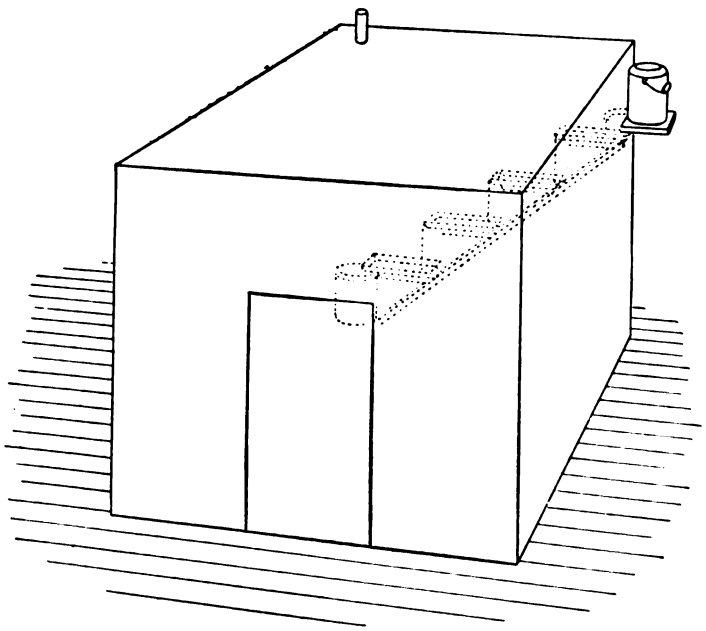
screws or bolts are drawn tight, air-tight joints will be secured. The top is put on in the same manner. The door can be covered in the same manner. When the frame-work is bolted or screwed to the floor, which oftentimes is uneven, use a half-round, under which is placed cloth saturated with the liquid glass and drawn down with screws. Then, after the box is set

AIR TIGHT BOX INEXPENSIVE.



PERSPECTIVE VIEW OF A CANVAS FUMING BOX

up entirely, give it a coat of liquid glass and two coats of paint. This will give an absolutely air-tight fuming box, inexpensive, but serviceable.

The arrangement of the can may be made as for the larger fuming room, or it may be placed outside with a tube running through the wall of the box into the first pan. The capacity of these pans, together with the final receptacle, should be a little greater than the supply can. After the box is loaded, the ammonia is turned on and led into the pan by means of a small tube. It can remain in this manner until the process is

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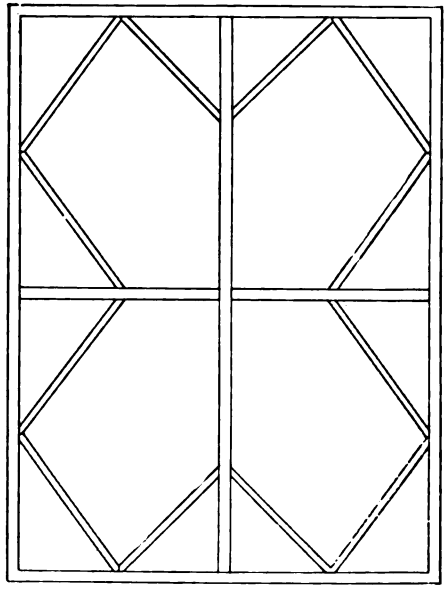
complete. The fumes can be exhausted by connecting the top of the box with a blower. The exhausting of the box will be accomplished quicker by opening the door an inch or two so that the same amount of air is let in as exhausted by the blower.

THIS PROCESS TOO SLOW AND UNCERTAIN.

While the process here described contemplates the evaporation of ammonia without artificial aid, the



SHOWING ARRANGEMENT OF FRAME-WORK.

process is objectionable. First, it is slow. Second, it is rather uncertain in its results, because of the liability of the ammonia to vary in strength. Third, because in purchasing and transporting ammonia in the liquid form, it is necessary to transport a large amount of water. An inventor, whose device is shown herewith, has sought to overcome all of these objections. The system depends upon liquefying the gas and accurately measuring it and then permitting it to enter the fuming box in a gaseous form only. In this patented system, the anhydrous ammonia is used, and it is claimed that the operator is placed in position to

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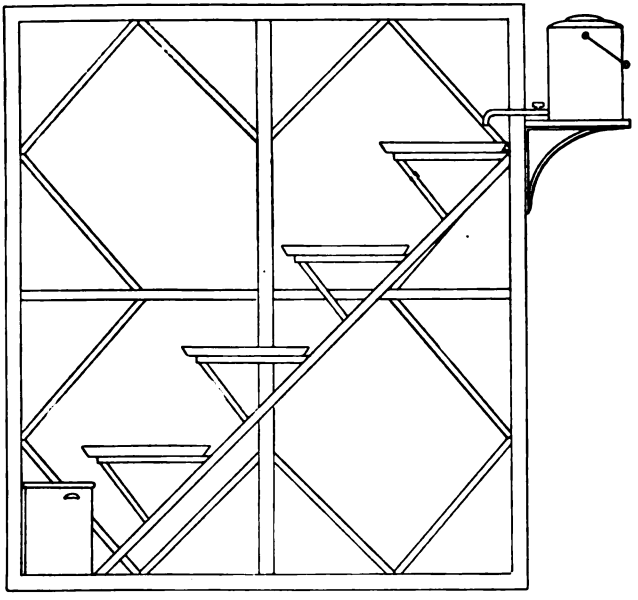
know absolutely just how much gas per cubic foot of space to use in order to produce a certain shade of color. It then becomes a matter of simple equation, thus: Space + gas = time + results. The operator will then work out his definite formula and control his shades by the amount of gas and time—space having become a known quantity. To do this, the

WORKMEN CAN GOVERN SHADE IN FUMING.



END VIEW SHOWING ARRANGEMENT OF AMMONIA TANK AND TRAY.

apparatus shown in the illustration is used. One pound of anhydrous gas is used for every 200 cubic feet of space in the fuming box. The apparatus works automatically. There is no danger whatever in connection with this method as, should an accident happen to the glass gauge, this supply of ammonia is cut off, doing away with any danger. The valves are all high pressure, tested up to 500 pounds' pressure, assuring absolute safety. The time required is greatly shortened by this system, as 12 hours of the fuming or over night, produces a greater effect than from 24 to 36

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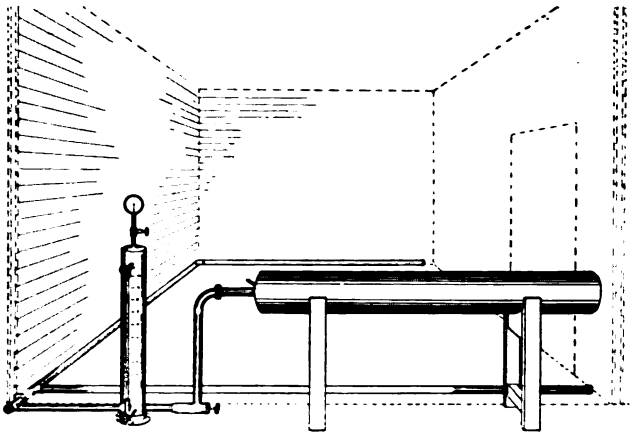
REAL FUMED OAK THUS PRODUCED.

hours by the old method. The operation of the system is absolutely accurate, as in setting the scale for weighing the amount of ammonia required there is no guess work or wasting of extra ammonia. The system is the application of a scientific principle taking advantage of a chemical change, controlling it all by an ingenious device which, in itself, gives to man the use of an



ILLUSTRATING A PATENTED AUTOMATIC AND MEASURING DEVICE FOR THE INJECTION OF AMMONIA GAS.

element by the simple turning of valves and the element then doing the work that he desires. Fumed oak, thus produced, is absolutely permanent. *Fumed oak that is fumed oak* is recognized from its imitations, and the older it grows, the better it gets, whereas, the imitation wears off at the edges, bearing its own stamp of imitation.

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CHAPTER XXI.

SOMETHING MORE ABOUT FUMING.

FUMED oak, as the name implies, should be produced by the fuming of oak. It is an established fact that when the unfinished oak is subjected to ammonia in its gaseous form, ordinarily called fumes of ammonia, the wood assumes a color which is now being marketed as fumed oak. The shades can be controlled by the length of time that the wood is subjected to the process, and the color can be greatly augmented by the application of boiled oil. The most beautiful results are obtained, however, by applying linseed oil heated, so it is just bearable to the hand, and then thoroughly rubbed into the wood. After it has dried, the process is repeated. This gives a fumed oak of that richness that is found only in furniture a good many years old. The process of today, however, is to use one part of boiled oil and from three to four parts of naphtha which, of course, dries a good deal quicker. This being thinned, penetrates the wood, and, to a certain extent, produces the hot oil effect. When this coat is dry, a thin coat of shellac is applied and then the piece is waxed and called finished.

FINISH SHADE CONTROLLED BY LENGTH OF FUMING.

This latter method produces a very creditable result, but it does not come up to the first-named method. When the fuming process was first employed, it was customary to use the wood of a single log. A more evenly-colored piece of furniture was the result. Today this would be a difficult proposition, because a piece of furniture is apt to be made up of wood from various logs. Again, these logs are grown on various kinds of soil. The result, therefore, cannot possibly be as uniform. After a piece made up in this way is fumed, and the oil coat has brought out the shadings and the oil is thoroughly dry, rub off any grease spots that may remain and even up by using a water solution of sulphur brown, blending it nicely by the use of a camel hair brush. (See "Blending.") Then give it

TEXTURE OF SOIL HAS INFLUENCE ON FUMING.

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a coat of shellac, preferably made of one part white shellac, one part orange shellac, and one or two parts of wood alcohol. Apply the wax.

There is absolutely no need of mentioning any other method for the use of ammonia. While it is true that it can be obtained from other methods, the time required and cost is prohibitive.

HOW TO SHORTEN TIME OF FUMING.

The important question is how to shorten the time required in the fuming process. While this largely depends upon the strength of ammonia, and the efficiency of the fuming box or room, it still is true that if it is possible to shorten the hours required to fume and to produce the necessary depth of color, the method would be welcome, especially during the rush season.

Just now there are compounds offered to the manufacturer which, by their application, reduce the time required in the fuming box. To a certain degree, it is playing one hand against the other. You pay for the labor to coat the work in order to save the time in the fuming box. If this were all that these compounds yielded, it then would be merely a matter of equipment and the cost of that equipment, but some of the compounds have merits other than that of saving time which is an aid in giving a deeper color and, to a certain degree, an aid in securing a more uniform result. Take work that is made up of various grades of oak. These will be found to yield a more uniform result by first having been coated with one of these compounds, and then will require to be subjected to the fumes of ammonia for a shorter time. The color effect is produced by changing the compound rather than calling upon the presence of the color-giving factor in the wood, tannin.

OAK YIELDS BEST RESULTS WITH AMMONIA.

We are aware of the fact that the oak yields the best results when subjected to the fumes of ammonia. This is due to the large percentage of tannin present. Therefore, is it not the most plausible belief that by supplanting the amount of tannin a quicker result and, also, a stronger result, a deeper shade, is obtained in fuming? It will be found that all of the compounds offered on the market are based on this theory, and that most of them depend upon their results for the

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tannin they contain. To satisfy the user of a fuming box as to the efficiency of tannin, and its kindred chemicals, let the following experiment answer the question.

EFFICIENCY OF TANNIN IN FUMING.

Procure a good sample of the various kinds of oak and, after it has been dressed, such as it would be when made up into furniture, coat small portions of each with the various strengths of the chemicals mentioned below. To be explicit, remember that each one is to be coated alike, a strip of three or four inches wide, so that later they can be laid alongside each other and the results compared. This will show, besides the general results, the difference which the wood itself makes, so that later on in actual practice, the strength can be changed to produce a uniformity on the different oaks.

Tannic acid can be purchased in reasonable quantities at about $1 a pound, pyrogallic acid at about $2 and gallic acid at 75 cents. Take one-half ounce of each one of these chemicals and dissolve each in a quart of water. Now coat each piece of wood with these solutions in three different places and subject them to the fuming process. It is well, also, to have always a piece of wood similar to that which is to be fumed along with the test pieces so that the difference can be more readily estimated. For the extractive compounds, procure some tan bark liquor, chestnut extract, quebracco extract and catechu, and make with these various strengths by adding one ounce to the quart of water. Apply these to the oak as described above. The results must give the answer to the entire problem of using chemicals or fuming compounds to hasten the fuming process.

COMPARATIVE RESULTS IN FUMING.

A greater uniformity can be produced in the fuming box if the wood, or piece of furniture, is coated with a solution of tannic acid, and pyrogallic acid, preferably one-half ounce of the former, and one ounce of the latter to the gallon of water. It has been found that when the fumes of ammonia have been applied at least four hours, a very even result is obtained, much more so than when fumed without the application of the acids. Where extreme differences of shade are shown, these can be overcome by wetting these places with naphtha which will bring out the discrep-

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UNIFORMITY PRODUCED BY USE OF SHELLAC.

ancy of shade. As soon as the naphtha has practically dried out, coat with a very weak solution of brown stain. For this, use a solution of bichromate of potash and jet black. Put enough of the black into the bichromate solution to give it the brownish tint. Understand thoroughly that this must be a weak stain. It will be found that when the shellac coat is applied, a uniformity is produced altogether more satisfactory than when the toning is done in the shellac coat.

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CHAPTER XXII.

FUMING OAK BY STAINING PROCESS.

TO better familiarize the reader with the general operation of the various steps in the production of fumed oak by the use of any of the several formulas given, and to bring out the great possibilities by the employment of various strengths of chemical solutions, these general suggestions will apply:

SUGGESTION IN STAINING PROCESS.

Where the stain method is employed, a good deal can be done to assist in producing the desired result in the first coat. A solution of two parts of bichromate, one part of carbonate of potash, calling the parts ounces, to the gallon of water, will produce a first coat. Apply this coat thoroughly, and let it stand 24 hours. Where a light piece of wood is laid next to a quartered darker piece, say red oak, let the stainer coat the entire piece, and then re-coat along the line of the light piece, blending it out. This, when it dries down, and receives the second coat, will materially uniform the shade. Again, the application of naphtha will assist. Understand that the naphtha has nothing to do with the production of the color. It merely helps to bring out the difference in shade, and the man that is doing the blending in that way will shortly know just how heavy to apply the blending coat, and can then dispense with the use of naphtha. Where the blending is done over the second coat of stain, care must be taken not to lift the second coat, so as to "pile it up," and thus produce blotchy work. It will not be necessary to sand these blended coats; the sanding of the first coats will have sufficiently smoothed the work.

GUARDING AGAINST "PILING UP."

In chair factories, where smaller surfaces are presented, the following method may be found expedient for dipping. It is purely a chemical proposition, and by no means a poor way to stain. Make a solution of the two acids recommended, and dip the wood; let it drain back from a wood drain board. Absolutely no metallic surfaces can be used, which means that the

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tank itself must be constructed entirely of wood. Immerse the piece, and see that it is covered thoroughly. Many times you will find that the dust from the sanding operation not being removed thoroughly, will keep the stain solution from getting into the wood. In cases like that, a sponge saturated with the stain, must be passed over these surfaces thoroughly. Again, sweaty or greasy fingers will keep this stain from penetrating. It is necessary to pass the sponge over these spots until you are certain that the same amount of stain has been applied as on the balance of the article. After this dipping solution has dried thoroughly, sand very lightly, just enough to remove all the fibers, and dust again. Then immerse the piece in a solution of bichromate of potash, caustic potash, four ounces to the gallon, or three ounces of each to the gallon, if a strong tone is to be obtained. Dissolve four ounces of sulphate of copper in a quart of hot water. Of this copper solution, measure from four to six ounces, preferably in a glass vessel. To the copper solution add an equivalent volume of stronger water of ammonia. When the ammonia is first added, a white precipitate will be formed, which is copper-hydroxide, but which immediately redissolves and forms a deep ultra-marine blue colored solution, with a very strong ammoniacal odor. This is due to the excess of ammonia, and as long as this excess of ammonia is present the copper will remain in solution. This blue solution, then, is added to the chrome potash solution which amounts to a little better than a gallon, but which must be in thorough solution, that is, the bichromate and the carbonate must have been dissolved. The sudden contact of a carbonate with water has a tendency so to harden the carbonate as to keep it from dissolving, and when it once gets into this condition, it is apt to stay in a solid form encrusted on the bottom of the vessel, jug or jar. In that way the resultant shade will be that much lighter. When the solution, however, is perfect, stir in the blue copper solution, and continually stir or agitate, with the result that a beautiful light green stain will be produced. This, then, is the second coat. Whether it be used with a brush, or whether it be used as a dipping stain,

METHOD FOR USE WITH SMALLER SURFACES.

IMPORTANT ITEMS IN PROCEDURE.

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it will form a rich brown when it comes in contact with the first coat. The chemical effect produced is very much like that when the same wood is subjected to the fuming box. It will not raise the grain as one would think; it will not attack the glue joints, as is often thought it would. The setting of it has been assured by the care taken in applying the first coat, but if this care has not been taken, it is self-evident that the neglect will be more apparent because the second coat has had no chemical to work upon, and thus a much lighter color will be presented where the first coat was omitted.

THE RESULT OF CAREFUL WORK.

When a formula of this kind is recommended, the reader must apply a bit of his own ingenuity. He can strengthen or weaken this solution; he can augment the second coat by the addition of anilines, bearing in mind that the mordant which sets the aniline is present in the chemical constituents of the stain, so that there is practically no shade of fumed oak, or brown oak, that cannot be produced with this method. Nor is it necessary that this be used on oak alone. The most beautiful and richest mahoganies, rosewood or cherry can be produced with this method. A decided chemical change is wrought by the application of these chemicals. Understand, if these are all mixed together they would be absolutely useless. The result is due entirely to the placing of the constituent upon which the second series of chemicals work, producing the chemical changes which bring forth the color.

COLOR TO BE JUDGED ONLY WITH FINAL FINISH.

I must emphasize that the judging of these colors, or rather the results, must not be done until the wood has received its finish, the shellac and wax bringing out a depth of shade far greater than would be expected.

Where the cost will permit an oil coat, before the shellac is put on, it will revive the wood and give it a richness and mellowness that cannot be produced by the ordinary way of finishing. It must be remembered that in a fumed oak finish rarely is it filled; whereas most of the other finishes are filled, and in that manner a certain amount of oil is received by the wood. Where the wood is not filled, this oil usually is omitted, with

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the consequence that we lack the depth of transparency which is given by the oil. One simply has to exemplify this by coating a piece of paper with oil, and then shellacing it, or simply shellacing a piece of paper, and holding both up to a light.

THOROUGHNESS IN FINISH BRINGS PROFIT.

Thoroughness in the finishing department brings profits. There are many corners that can be cut when the department is systematized, and where the operators have a thorough acquaintance with the materials at hand, where every handling of the piece counts. A directness of purpose—no rule-o'-thumb methods—records of operations in black and white, so they may be repeated and duplicated at a moment's notice, are a few of the things advocated.

POTASH SOLUTION HELPS IN SHADING.

In the factories where fumed oak is produced by the staining method, it happens often that in their endeavors to produce a certain matching the difficulties are noticed mostly in the flake. To reproduce the peculiar color that the flake assumes in the fuming process has baffled the staining room more than once. Some of the shades can be produced by sponging the wood with a strong potash solution to which has been added bichromate of potash. This is satisfactory where the yellowish shades predominate. The flakes will take on the color and the same will be permanent, but since fumed oak is being made darker this method no longer suffices to match the genuine fumed, as far as the flake is concerned. This can be done, however, by using a very weak solution of iron in the first coat, or better, in the sponging water. Add to the gallon about one ounce of sulphate of iron, and let the work stand over night before any more work is done on the piece. It will have taken on a light blue gray color which can be partially sanded off and the process proceeded with. That is, the brown coats applied when you will notice that the flakes will take on the shades produced by the regular fuming process. All in all, this is a ticklish procedure, as no two pieces of oak will give the same depth of color.

In high grade work this can be done nicely, as a piece that has a good many flakes can have a heavier coat of the sponging solution, and in that way the flake

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receives the iron salt required to produce the shade that is now in vogue. It always must be remembered that the flakes present the most difficulty in taking on any kind of stain and, therefore, must be handled with such chemical solutions as are best adapted to penetrate and produce an effect upon them without depreciating the other part of the timber. The sanding will take off some of this effect, and it is peculiar, but nevertheless true, that it evens up when the final results are obtained. That is, it is particularly noticeable after the first coat of shellac.

FLAKES PROVE DIFFICULT TO STAIN.

Usually the fumed stained coat has in it a brown, black, orange and in some formulas yellow. From this make-up you will recognize how it is that by putting a bluish gray on the work for the underlying coat the flake takes on the color that is produced in the fuming process. Take a thoroughly fumed piece of wood and examine it closely. You will notice that the center of the flake is hard and glassy appearing and that the outer part of the flake is of a lighter shade and does not seem to have taken the color as did the center or any other part of the wood. It is absolutely correct, but they must harmonize. It no way can the flake stand out as an individual, rather than the component part of the entire board.

This can be controlled by the handling of the first two coats. The iron solution must be in harmony with the orange or yellows in the brown mixture. When you get a line on the shade you are after, a few little testings will suffice to give you the definite formula. You know why you are using more or less of these two colors, and by watching the effect upon the flake, the balance of the wood will come out in beautiful harmony with the flake.

CARE NEEDED WITH IRON COAT.

The only place where extreme care is required is where the iron coat, or sponging coat, is applied to the fine grained wood or sappy wood. The operator must apply the solutions sparingly to the close grained and not at all to the sappy portions. Where the greenish effect is desired in the fumed oak, it can be produced by using the iron solution in the sponging coat stronger and the yellow in the brown coat, thus producing the

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greenish effect. Another way is to avoid entirely the use of the iron and produce the green by using a preponderance of yellow and green aniline in the stain coat. This is merely mentioned to give the reader an idea how to go at it. A bilious looking fumed oak is never going to stand the test of time. It does not harmonize with the usual decorations of the home. It is a harsh contrast with wall finishes and other decorations, and to the manufacturer who has a call for it the foregoing will give him an idea how to go at it. There is little to worry about, as it is almost impossible to find two pieces of the new idea of fumed oak that will match each other.

HOW TO AVOID USE OF IRON COAT.

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CHAPTER XXIII.

ACIDS AND THEIR USE IN FUMING.

AS THE words "tannin," "tannic acid," "gallic acid" and "pyrogallic acid" are being used frequently in this book, undoubtedly a more detailed knowledge of what these substances really are is desired by those whose occupation makes it necessary for them to know their uses. What may be said here will serve as information relative to the source and general constituent of a commodity which is being used more and more in the production of colors in the finishing room.

WHERE THE TANNINS COME FROM.

TANNINS or TANNIC ACID are terms applied to a large number of rather complex organic substances found in various parts of many plants and trees in certain abnormal or pathological growths (galls) occurring on the stems or leaves of many plants. In general they are light amorphus solids, pale yellow or brown in color, soluble in water, having an astringent taste, and giving a blue black or olive green precipitate with ferric (iron) salts. They form insoluble staple compounds out of gelatine and albumin, this property being made use of in the process of tanning. The tannins may be divided into two groups: Those obtained from abnormal vegetable growths, such as nut galls, and those obtained from the healthy portion of the plant. At the present time, tannin is obtained from the palmetto, which grows in our South, quebracco and from the chestnut tree. All are indigenous to our own country. Gallotannic acid, digallic acid, ordinary tannic acid, is a most important member of the first class. It occurs in the gall nuts of the various varieties of the oak, in the Chinese and Turkish gall nuts and in certain kinds of sumac. The chemical formula is C. 14. H. 10. 0.9. It may be considered anhydride of gallic acid. It passes to that body when heated with dilute alkalies. Gallotannic acid is used in the preparation of gallic and pyrogallic acids, in the

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preparation of ink; in medicine as an astringent, and as a mordant in dyeing.

The most important tannins of the second class are found in the bark, wood and leaves of the oaks and hemlocks. Many other similar acids, such as querci tannic acid, from the oak, of somewhat uncertain constitution, are known. These are said to be a reddish white powder, slightly soluble in cold water, more readily in diluted alcohol. Undoubtedly many of these acids are present in our woods, as used in the industry, and it is upon these that we depend to a certain degree for the color produced when chemicals are applied that are affected by the presence of the tannins and kindred acids in the woods.

GALLIC ACID COMES FROM GALL NUTS.

GALLIC ACID is an acid which exists in a small quantity in gall nuts, in Valonia (the acorn cups of the oak), in pods of sumac and other vegetables. It is usually prepared from gall nuts which, in addition to the gallic acid, contain a large proportion of tannin (tannic acid or gallo-tannic acid). When the gall nuts are digested with water for some weeks, fermentation takes place, and the tannic acid is gradually converted into gallic acid. The same result is obtained more quickly if sulphuric acid be present. To obtain pure gallic acid, the gall nuts are boiled with water and the hot liquor separated. On cooling, gallic acid crystallizes out, and is further purified in the solution of hot water, and treatment with animal charcoal. It forms delicate, silky crystals, nearly colorless, and having a sourish taste. It is soluble in boiling water, but only one part to one hundred in cold water. On this account it can be readily purified by recrystallization. With a solution of iron, it produces a blue black color, and finally yields a black precipitate on exposure to the air. Hence it may also be used in the production of ink, for which purpose it has some advantage over tannic or gall nuts. When the crystals are strongly heated, pyrogallic acid is produced, and sublimes over. Gallic acid is useful as an astringent as it does not coagulate albumin. It is readily absorbed into the blood, but where a decided local astringent effect is desired, tannic acid is much more powerful. This bit of information

GALLIC ACID AN IMPORTANT ASTRINGENT.

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is of value to the factory man, as in cases of cuts or slight injuries a tampon, soaked with a 5 per cent solution of tannic acid will act as an astringent and stop the bleeding.

PYROGALLIC ACID, PYROGALLOL or TRI-OXY-BENZINE are produced, as stated, by the action of heat on gallic acid, carbon-dioxide being eliminated in the process. Fine, colorless needles or plates, readily soluble in water, less so in alcohol or ether, melting point 102 degrees C. It is valuable because of its great affinity for oxygen. Its alkaline solution is used to absorb oxygen in gas analysis. It forms a number of derivatives, some being valuable dye stuff.

PYROGALLIC ACID RESULTS FROM HEATED GALLIC ACID.

With this short description of the three vegetable acids which today are playing such a strong part in the production of fumed oak, we can readily see wherein we take advantage of their peculiarities in producing stains.

Pyrogallic acid can be made up into an alkaline solution which will turn brown, and this gives to the finisher a new line to experiment with. At the present time we are applying a mixture of tannic acid and pyrogallic acid and follow it with a mixture in solution of bichromate of potash and carbonate of potash or soda. Pyro, as it is commonly called, will permit of making the solutions all in one, and it only remains to take into consideration the amount of each chemical that will remain in solution and be of sufficient strength to produce the depth of brown now conventional as fumed oak. We have gone to the products used by the tanning works to obtain our dye stuffs in a crude way; that is to say, the extracts are of more or less variable strengths. The percentage of tannin is really all we rely upon, and as the extracts known as tan bark extracts generally were not standardized as to the definite strengths of tannin, our results necessarily were uncertain, and therefore, we reverted to the use of tannic acid and pyrogallic acid themselves. These are of uniform strength. Their application has been treated upon heretofore, but the man who is supposed to be using these commodities can better understand the handling of them when he has some

TANNIN AND PYRO ARE OF UNIFORM STRENGTH.

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knowledge as to the source of his supplies. To tell why a color is produced, and what changes really take place, would be stepping into organic chemistry, which is complex to say the least, and could not be expected to be comprehended by the craftsman. But the simple statement that the results obtained by the processes and formulas given are absolutely permanent and definite, must suffice. To know and to be positive of this statement only requires a few experiments to convince the skeptical.

WHY COLORS PRODUCED IS A MATTER OF CHEMISTRY.

The chemical changes which take place and through which the color is produced, are according to the laws of nature, and while nature works many freaks, it never belies itself. To take advantage of the natural changes produced by the various applications of nature's products is but to help oneself. It is important that one become familiar with these changes and processes which are here offered and which are ours by mastering them.

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CHAPTER XXIV.

GLUE JOINTS THAT PART IN FUMING.

WHEN difficulty is encountered in glue joints parting during the fuming process, it will be found due to one or two causes—glue or humidity in the fuming box. When this trouble arises, do not condemn the glue in itself; it may be a fault in its application or in its preparation and general treatment. A quick remedy is to have about 1 per cent of alum dissolved in the water. This has a hardening effect and it has been found glue joints made with alum will withstand the fuming process under all conditions. One thing is to be avoided when steam is employed to agitate the final drippings of ammonia; never should it be allowed to escape in the fuming box.

PROCEDURE TO FOLLOW.

Joints that are not made true, where the glue is applied so thickly that you might almost call it a space filler, are dangerous at best. The amount of glue is so great, the surface so large, subjected to all kinds of atmospheric conditions, that ammonia gas may have a detrimental effect; but this is a fault of the woodworking end rather than of the staining department, although manifested only when the finishing department receives the work.

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CHAPTER XXV.

THE MANIPULATION OF STAINS.

IT IS safe to say that very few published formulas exceed, or come within, the solvent limit of their solids. The difficulty of overloading the liquid is usually encountered in endeavoring to get a dark or heavy shade, but this can always be avoided by change of materials. Whenever a color or stain requires more of the color material than remains in solution, it is well to quit at once the attempt at producing a stain with that material. It then becomes more of a paint. With the later stain materials this is rarely the case. It is only by the use of the older method that these difficulties are encountered. When a formula is once established and the resultant shade correct, the necessity of bearing the foregoing recommendations in mind must be apparent. Again, it is taken for granted that formulas are made up of materials, the standard of which can be maintained. In this day, when aniline colors can be obtained in almost every conceivable shade, under normal conditions, their use is recommended. But in cases where extracts of vegetable matter are employed, uniformity must always be guarded by keeping for comparison the original solution made up from the same material as that employed in building the original formula.

FEW FORMULAS COME WITHIN SOLVENT LIMIT.

MAINTAIN UNIFORM STANDARD.

For this purpose, adopt a uniform standard, say, for example, use one ounce of your color material, and dissolve it in sufficient water so that a light shade of the color is produced, label it and put it away. When the next batch of the same material is purchased, make a like solution and compare it. If it corresponds with the original sample, it is safe to employ in the future stains, but if it runs darker, you will have to lessen the quantity, and if it runs lighter you will have to increase the quantity. This precaution is not necessary where anilines are employed, but is safe to carry out, especially where color material is offered at reduced

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prices. The reduction is usually compensated for by a similar reduction of the color value furnished. Unfortunately, this reduction is made by the addition of salt, sugar or dextrin. Take a high grade color for which the market price is 70 cents. It may be offered to you for 60 cents, the difference being made up by that same percentage of salt in the product shipped to you. This is not detectable in the physical appearance of the dry color received, and often it is not noticed until the last finishing coats are applied. Ofttimes this reduction is made gradually and then it is not noticed for months after until, perchance, a piece of furniture is compared with one made in a previous year. While this is not a common occurence, it is, however, one of the many obstacles that the foreman finisher has to contend with in maintaining the general uniformity of his stain.

REDUCTION OF COLOR VALUE TO BE AVOIDED.

The preparation of stains in the factory does not alone depend upon the mixing of colors and dissolving them in a liquid, but it depends upon a more or less familiar knowledge with those colors that go to produce a desired shade. The writer has often cautioned the consumer, when purchasing anilines, to insist upon getting acid colors or direct colors—preferably acid colors. Where a certain shade cannot be produced with the acid colors at hand, direct colors may be used. Again, where mixtures do not produce the desired effect, try to obtain the desired shades by applying one coat over the other. Where chemicals are employed, there are only a few that are to be avoided. They are notably the permanganates, silver salts, or the weaker salts which are easily affected by any of the vegetable acids that may be present in the wood. Sometimes the change so produced is calculated to make a component part of the desired shade, as in the oaks. The tannin will affect the iron salts by producing tannate of iron. The amount of tannate of iron produced then depends upon the amount of tannic acid present in the oak, and as this varies greatly, there is only one way that definite results on oaks can be produced.

THE CHEMICALS THAT SHOULD BE SHUNNED.

Inasmuch as a good many of the present finishes depend upon these two chemicals, it might be well to

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give to the reader a method for definitely producing the shades always uniform by taking advantage of this chemical change. It is known that there is nothing more absolute than a chemical. Therefore, take an iron solution of a certain strength, and a certain amount of tannic acid would change all the iron present to tannate of iron. Tannate of iron is a grayish black. The weaker the solution, the weaker the color. As the wood is an unknown quantity as far as the amount of tannin is concerned, it becomes necessary, in order to get a uniform shade, to have one of the chemicals of specific strength, and the other one in excess, so that you are positive the color-giving products are entirely exhausted by the chemical change.

HOW PRODUCE SHADES ALWAYS UNIFORM.

Therefore, we take a definite solution of the iron salts. See to it that there is enough—yes, more than enough—tannin present to effect the change. We coat the wood with just enough tannin or tannic acid to neutralize the iron solution, depending upon the tannic acid present in the wood to be in excess. This assures a certainty of results. Of course, the finisher knows that weak solutions always can be neutralized. It is safe to say that any kind of oak contains enough natural tannin present to overcome a one to three per cent solution of iron salt.

In a following chapter, where formulas are to be found, the production of different shades, all depending upon chemicals, will be given, but the principle involved in many of them is the same as the preceding illustration.

COLOR OF WOOD MUST HAVE CONSIDERATION.

The preparation of stains, as far as possible, should be the final operation of the color-producing attempt, but there are cases where it is simply impossible to meet the demands of style and fashion with just one operation. It is unfortunate that natural wood varies in its tone, and that in each and every case the result forces us to take into consideration the color of the wood in the building of every formula. For instance, the man who is using birch or maple in the making up of mahogany makes it necessary for his foreman finisher to take into consideration the difference in the wood when he stains this piece of furniture. The fin-

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isher, under these circumstances, in making his formula, increases the strength of the stain which is to be applied, to the lighter woods beyond the stain for the darker wood, so that the results will be uniform. Or if he is using part mahogany, he will make the stain so that it will give the desired shade and matches up the lighter woods with the darker stain. A simple way of testing these matches is to wet the stains with naphtha after they have dried, and make the comparison while the naphtha is wet. This proposition, however, will not work out satisfactorily on oil colors, for it is apt to make them run.

SIMPLE WAY OF TESTING MATCHINGS.

In making up the formula, many foremen finishers have found that an increase of from four to six per cent of color comes very near to making the matches. The procedure for making oil or spirit stains is very similar to that of water stains, where anilines are employed. There are but a few vegetable products that can be used in the latter solvents, and we recommend the omission of them entirely. Pigments should never be used as a stain. Where colors are produced, by their use, it is better to classify them as paints or graining colors. But many of our up-to-date finishes depend upon the color produced in the pores of the wood by the filler. These are notably employed in porous woods where the pores are filled and the filler usually colored with pigments that harmonize with the general tone of the finish.

MANY FINISHES DEPEND ON WOOD PORES.

Spirit mahogany must come in for consideration, because none of the stains that are used in making it have been mentioned in the preparation of water stain Spirit mahogany is nothing more than Bismark brown, of which there a good many varieties and strengths. A good quality of Bismark will make a very admirable spirit mahogany. However, it is necessary to caution the users of Bismark brown, because they are apt to use more powder than is required. Every stain powder that is soluble has a certain percentage of solubility, and beyond that there can be no solution. For instance, if a gallon of alcohol will dissolve four ounces of Bismark brown, all that is added above the four ounces is merely mixed with the alcohol the same as

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you mix white lead and oil. This is where trouble arises. You do not get a deeper shade, but you are very apt to get blotchy results.

For instance, where an alcoholic stain is used, and no filler, the next coat is usually shellac. The alcohol in the shellac picks up some of the Bismark, and then it leaves it in brush marks on the work. But, worse than that, Bismark brown is both soluble in alcohol and in water, and sparingly soluble in oil. When it is used in excess, you are apt to have the same difficulty without any benefit. Therefore, always see that the amount of your stain powder used is dissolved. After the solution is made, let it stand for an hour, and pour it off.

SHELLAC COAT FOLLOWS ALCOHOL STAIN AND NO FILLER.

If you find dregs, you can make up your mind that either you haven't given it time enough to dissolve or that you are using more powder than necessary. In such a case, where the depth of color cannot be obtained by the straight Bismark, add spirit black. A very little of this will work wonders on the spirit stain. One of the best signs that too much mahogany, or rather Bismark, has been used is the bronzing of the aniline after the alcohol has evaporated. Of course, this is all done away with, as a rule, when the shellac coat is applied; but it is just that much more than is required and has a tendency to take away the transparency of the stain.

Finishers often have wondered why they have a sediment in their mahogany stain. This is usually found in the cheaper stain powders where the reduction in price has been made up by the addition of dextrin or similar inexpensive fillers. After the advent of red and brown, a formula was sold to the manufacturers in which was given a certain black, scarlet and orange, and which makes a very good mahogany. It placed in the finisher's hands the colors which go to produce almost any shade of mahogany stain. In speaking of colors, it may be well to repeat that these articles are handled with the general understanding that by colors we mean aniline dyes.

WHY SEDIMENT IN MAHOGANY STAIN?

Many of the finishers are using this formula. With it they are able to produce and match anything that

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comes along in the mahogany line, but the buyer in the office again is looking at price. All he often can see is the number of pounds. The result is that this formula is supplied at prices varying 100 per cent or more.

AMOUNT OF STAIN POWDER DEPENDS ON WOOD AND SHADE.

The amount of stain powders requisite depends upon the kind of wood used and what shade is to be made. The colors recommended are water soluble, and should be fast to light. It is, however, a fact that many finishers have gotten the idea that the addition of a little lye helps set the color. This is not the case. If the mahogany stain is an acid color, it is absolutely wrong to use an alkali, such as caustic potash or soda. It merely requires a certain amount of color to neutralize the potash. It, probably, works out this way. The alkali present may help to penetrate. The stain seems to take hold of the wood better.

While this is not to be denied, yet, chemically speaking, the proper addition would be bichromate of potash. This would chrome the color, would be a natural mordant, and would help the penetrating of the stain, but not that alone. Bichromate of potash, in itself, has a color-giving value, and especially when put on mahogany. Many formulas recommend the use of one ounce of bichromate to be dissolved in a gallon of water before any of the mahogany stains are added. The amount of color can be offset by lessening the amount of stain powders.

You will find, too, that the stain will not lift up and in sanding not so much of the color will cut away. Acetic acid has been recommended. Two ounces to the gallon of stain is given by an English writer, but from actual tests made from this formula, it is a question, in the writer's mind, whether this is a good formula. For a time, chromic acid was used by our finishers and chemists. This is a red crystal and, in itself, makes a good stain; but on account of its cost and on account of its corrosive nature, it is being discontinued. When this acid is present, stain cannot be kept in metal tanks. The acid is rather uncertain in action, and certainly cannot take the place of its salt, that is, bichromate of potash.

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CHAPTER XXVI.

QUALITY NEEDED IN STAINING.

WHETHER or not you are using mahogany, or whether you are using imitation woods, you want to use a transparent stain and a filler which will not mud up your woods. There are places for water stains, for oil stains, and for spirit stains. But it is a peculiar fact that water stains are nearly always used on the high grade furniture. The cheaper the furniture, the more varied are the products that are used to produce the colors. But we are not discussing the merits of stains—we are talking about transparent stains, and as most of the muddy colors are offered on imitation woods, the following procedure for birch is recommended:

TRANSPARENT STAINS AND CLEAR FILLER TO BE USED.

For imitation mahogany where birch is used, prepare the first coat by dissolving a pound of potash in 50 gallons of water, and enough of bichromate of potash to give this water a decided orange brown look. When these are thoroughly dissolved, add one half pound of mahogany stain, made up of the red and brown, in such proportions as you would use to produce the shade you are using, were it used full strength. Apply this to the birch furniture. When dry, sand down thoroughly; then apply the stain, made up of the stain powder and water only, but with bichromate of potash. Shellac with equal parts of orange and white shellac, then varnish.

You will notice that the filler has been omitted. When this method is used birch does not require a filler. It is because of this filling that so much muddy imitation mahogany is on the market. Suppose you have a piece of furniture made up of mahogany, a good deal of which is veneer, and where the pilasters are of birch. Use this method on the birch, fill your mahogany, and we will guarantee that the birch will look much better than had it been filled.

Some of our best manufacturers, according to that

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traditional method, are still oiling between the stain coats. The results are naturally a muddy, blotchy imitation looking piece. Cut out the oil coat—it is too expensive. Your stain will not take hold evenly and you cannot get the transparent effect on the mahogany. It is all right to use it on oak, especially in making fumed oak with stain, but it is absolutely out of place in the production of imitation mahogany especially if you want transparent results.

BLOTCHY WORK RESULTS FROM OILING BETWEEN COATS.

The same process may be applied to gum wood. A thin filler may be used according to the quality of the furniture turned out. But the filler employed must be transparent. Somebody here is going to say, "How can a filler be transparent?" It cannot be, but there is such a difference in filler that we use the term "transparent" to designate those that clean up well from those that paint. Many a filler has been condemned because the application of it has not been properly done. By transparent filler is meant one that is made of silex and not one that is made up of starch, or whiting, or the very many other substances used for filler. We are not discussing the qualities of filler, but rather that which in the filler causes the muddy results.

On a finely grained wood the filler should be applied thinner, and it must be cleaned off with greater care than on a coarse grained wood. On a coarse grained wood, such as oak, where the pores are large, and the flakes comparatively harder, the filler itself will clean up easier. But where the wood is softer, as in gum, it will adhere and form a paint-like coat unless care is taken in the cleaning up. Do not endeavor to produce a color with the filler. The filler should match only the general shade of the wood and should not be used as a shade producing material like a paint. It is wrong to put a black into a mahogany filler. That color is too cold. That is one of the troubles with imitation mahogany. There is something about it that is cold. This is not so with the genuine piece made of the natural wood. The filler should be colored with Van Dyke brown and rose pink which will produce any depth of shade desired. When the filler is used

FILLER SHOULD MATCH ONLY GENERAL SHADE.

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judiciously and properly cleaned up, the colored wood will show through and give you the transparent, and not painted, effect that is wanted.

The foregoing is written on the presumption that water stains are used. Where oil stains are used, the filler may be omitted on either birch or gum, but care must be taken that the shellac coat does not lift the color and give you uneven results. Where spirit stains are used, a little shellac added to the stain will help to bind it so that the subsequent coats will not lift. Oil stains are preferable to spirit stains, and usually any shade of oil stains may be obtained. The transparency, too, may be had. The men applying the oil stain will soon learn that they must not lap the color and thus avoid uneven results. For quick work for the factory turning out quantities, unquestionably the oil stain has taken the place of the water stain, but we do not recommend the mixing of the filler in the oilstain. That is where the muddy color is bound to come in, because the filler is bound to be deposited in a thin coat over the entire work.

FILLER MAY BE OMITTED WITH BIRCH OR GUM.

It is impossible to cover every detail. The reader looking for specific information must let these chapters serve to suggest to him places and points from which he is to obtain results.

I cannot write that which will apply to a chair factory making two dollar chairs, and which, at the same time, will answer the requirements of a factory making high grade bed room suites. But the suggestion, the methods offered should serve to prompt ideas and to bring out results, applicable to each individual case.

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CHAPTER XXVII.

UNIFORMITY OF COLOR DESIRABLE.

WATER stains are generally made by putting into solution color-giving products with the design of having this color permanent and uniform. In recent years the anilines have furnished practically 95 per cent of this material, the balance being made up of such as bichromate of potash, sulphate of iron, chloride of iron, chromic acid, from the chemical list, and from the vegetables or plants, such as logwood, japonica, chestnut, fustic, bloodroot, madder, etc. The latter, however, from a scientific point of view, are not to be recommended owing to the fact that it is rather uncertain as to the strength of color you are apt to get by relying on any one sort of material for color, as no two growths will give the same percentage of color-giving material, and the finisher who makes up a stain of this class must keep doctoring his formulas so as to make up the various deficiencies of organic color material.

MOST WATER STAINS ARE ANILINES.

Even if these are used in connection with chemicals, the fact remains that they are rather uncertain, and therefore, in the writer's opinion, it is well to eliminate them entirely from the stain category. Further, because there is not a known shade that cannot be produced, and better at that, with the anilines. The few stains that are being made today solely with chemicals depend mostly upon the chemical actions that they have on the color-giving materials found in the woods, such as the oaks, which when coated with various strengths of iron solution will produce from light gray down almost to black, depending entirely upon the amount of tannin (tannic acid) present in the wood, and the strength of the iron solution employed.

It is known, of course, that it does not matter whether you use a solution of sulphate of iron or chloride of iron, the tannic acid has an affinity for the iron and thus replaces whatever acid may have

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been combined with it. This would be known to the chemist as a chemical change in which an acid reaction has taken place and in consequence thereof would come under the classification of not only a water stain but as an acid stain. On the other hand, take the same wood, oak, and apply to it a strong solution of caustic potash, ammonia or caustic soda. These are the stronger alkalies or solutions of salts of tartar and sal soda which are chemically carbonate of potash and carbonate of soda, making the weaker alkalies. When either the stronger or weaker alkaline solutions are employed they will produce a yellowish brown down to the darker shades of brown, thus again depending upon the color-giving material naturally present in the wood.

TANNIC ACID AN IMPORTANT FACTOR.

From this we see that tannic acid plays a strong role in producing colors on oaks. The difficulty that arises from depending upon the presence of this color-giving material, tannin, is the fact that it is not uniformly present in the different boards. The finisher does not know from how many trees and from how many different places the trees from which the boards assembled in one piece of furniture have come. Therefore, he cannot expect uniform results by depending upon either the acid or alkaline method for producing any desired shade, but he can take advantage of this natural state of affairs and augment the color-producing chemical by supplying the deficiency. This is done by coating the wood with a solution of tannic acid and then applying the chemical solution, all of which, however, must be worked out to a nicety. Where a certain piece, say one panel of a table top, does not match up, it must be gone over until the desired depth of color is produced.

There is still another method available, and that is to employ anilines that permit of mixing with acids or acid-reacting chemicals, and it is necessary, therefore, that the finisher supply himself with colors known as those belonging to the acid group. Anilines are broadly specified as acid colors, basic colors, spirit colors, oil colors, and direct colors. For the furniture industry the chief interest lies in acid colors with a few direct colors that can be mixed with the acid colors

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but never using a basic, spirit or oil color with either of the other two.

To exemplify the procedure wherein a color is used, which is to augment the results obtained when it is desired to take advantage of the nature of the wood, and the chemical reaction, we would suggest that the wood be coated with a 5 per cent solution of tannic or a 3 per cent solution of pyrogallic acid. After dry, sand lightly and apply a coat made up by using four ounces of bichromate of potash, two ounces of caustic potash to the gallon of water. When this is thoroughly dry coat with raw linseed oil.

WHAT TO DO WHEN COLOR IS USED.

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CHAPTER XXVIII.

USE OF OIL STAINS IN WINTER.

THERE are so many ways of making oil stains, so many solvents that are used, that to put one's finger on the spot and name the difficulty without knowing the formula employed is impossible. Any oil is more limpid in warm weather than in cold weather. To exemplify this we need but refer to butter. It is easily spread in warm weather, but it is more difficult in cold, and it is a peculiar fact that the chill it receives from being in the refrigerator is altogether different from that of zero weather.

EFFECT OF CHILL ON STAINS.

I bring this to the reader's mind and ask him to bear it in mind when using oil stains. If he does so he will overcome a good many of the difficulties. For in cold weather oil stains do not spread well, do not penetrate as well, and if the material to be stained is brought in from a cold room, the troubles are more numerous. Oil stains, which are built up with resinous material, such as japans and cheap varnish, are those which will be affected by the cold weather. Not only are these difficult to work, but the color is apt to be heavier and the brush marks are often lapped. The oil stain, in which the finisher incorporates some of the filler material, is not excluded, for as a rule a composition stain carries with it a certain amount of this resinous material. In consequence, the spreading and the penetrating qualities are absolutely different than during the summer weather, at which time the material works at its best.

In many formulas that have been given for producing oil stains, in which the solubility of the color depends upon the stearic or oleic acids, and where benzole constitutes the prime solvent, a bit of rosin should be added to overcome odor and give color. I refer to cases in which the solvents named are used with artificial turpentine, by which is meant those distillates differing from naphtha in specific gravity, but higher

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than the kerosene series or those made from the asphalt beds, and not those made by coloring naphtha and by adding fire weed oil. These stains so made, when employed in the ordinary temperature have a sufficient amount of penetrating proclivities and evaporate so fast that the temperature does not materially affect them. Their evaporation is so speedy that cool weather is rather desirable. The main necessity is a circulation of air.

THE THREE PROMINENT SOLVENTS FOR STAINS.

Creosote oil, gas oil or crude carbolic acid are three of the prominent solvents used by stain manufacturers, especially those making shingle stain. They also enter into the furniture stains in various proportions. The odor is disguised by the use of oil of citronella or oil of mirbane, sometimes a bit of sassafras. The latter two are so cheap and so strong that the quantity required does not prohibit their use; in fact, they are coal tar derivitives. They belong to the artificial class of volatile oils. The sassafras never saw the sassafras tree. In the stains where the vehicle, or even a part thereof, is a creosote oil, difficulties are usually encountered in zero weather.

In a recent circular letter, a clear and concise reason is given for the difficulties that are now being reported and complained of by those who are using oil stain. A statement is made that "creosote salts are just as characteristic of ordinary creosote oils as ordinary salt is characteristic of the ocean water." It is claimed further that it is just as foolish to expect ordinary creosote oil to make good stains as it would be to expect the ocean waters to be good for drinking purposes. They are both too salty. When the thermometer registers close to zero, a barrel of ordinary creosote oil, gas oil or crude carbolic acid will show from 10 to 20 gallons of residue known as "creosote salts" or "crude naphthalene." Good as this "naphthalene" may be as a moth preventive, it is not valuable when you are buying a stain solvent. You do not want a third of it to be a solid, and absolutely deleterious to stain materials. Whether this naphthalene shows as a residue or is held in solution in the oil as is the case in warm weather, the fact remains that the

CREOSOTE OIL DOES NOT MAKE GOOD STAIN.

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naphthalene is there just the same, and is bound to cause trouble sooner or later.

For stain purposes you want oils that are limpid, free from these objectionable salts. Every solvent can carry in solution only a certain amount of solids. If, therefore, it is already burdened with from 10 to 30 per cent of foreign material, its solvent qualities are reduced by that percentage, which is present as a bi-product or adulterant. Crude naphthalene is so cheap that it does not pay the manufacturer to remove it, and thus it usually is sold in the creosote oil. The seller of the oil says nothing as to its presence; the stain manufacturer knows nothing of its presence until a complaint arises or he luckily passes over a period of time about in this manner.

LIMPID OILS ARE BEST FOR STAINS.

His stains are mixed during warm weather or in a warm room, and are consumed in the same manner. If a barrel of this oil happens to become chilled and the naphthalene crystallizes, he may be lucky again by merely being able to draw off the thus inadvertently purified creosote oil. Once more any difficulty has been avoided.

While this makes manifest that the high grade article is the better, it at once gives us an ordinary method for specifying the grade of oil we want and a method for detecting the naphthalene. With the naphthalene some chemists claim other injurious compounds present are crystallized, thus automatically removing themselves. While treating on the subject of crystallization of the naphthalene, etc., let me say in order to establish a uniform standard, if the oil is purchased in five gallon, ten gallon, or even barrel lots, it is desirable that a certain definite uniformity of results in colors, spreading qualities and penetrating qualities be established. Obtain an ordinary hydrometer for heavy oils and a hydrometer jar. These should not cost more than 75 cents or $1.00. Take the specific gravity or reading; then chill the oil, keep it in a freezing temperature and again take the specific gravity. You will find that a certain percentage of solids appears. By pouring off the limpid liquid, bringing it to a uniform temperature, the reading will be different. The most

GETTING UNIFORMITY OF RESULTS.

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opportune time for this experiment is during the freezing weather, as a lower and a more steady cold can be obtained. In that way the crystallization of the impurities will be more pronounced. Having established a specific gravity, and the formulas built thereon, it is an easy matter to make this standard a specification of future orders.

USE OF LOADED OIL BRINGS ON TROUBLES.

I have mentioned that this impurity is injurious to oil stains, and I will endeavor without going into technicalities to show wherein the use of a loaded oil is apt to cause an endless number of troubles which are difficult to locate and which vary in the same ratio as the amount of impurities presented. Take, for example, a pet formula in which a certain amount of color material is given—say eight ounces of mahogany oil soluble, one quart of benzole in which to cut it, and three quarts of creosote oil. For the sake of argument, it is admitted this formula has been working satisfactorily. It was made with a very good grade of creosote oil. The next batch comes in during the summer, but is loaded with 25 per cent of naphthalene. It works a bit heavier, and does not seem to have the penetrating power. It needs to be doctored. A little more benzole is added, then the color is too light in shade; then a little more color is added. Right here is the first mistake. We have left our regular formula and commenced to doctor, and in all probability have not kept a good record of the quantities consumed in the doctoring. The result is that our regular formula is thrown in the air, and the foreman finisher's troubles are multiplied.

"DOCTORING" FORMULAS.

Still he keeps fussing, and the cold weather comes on. Over Sunday the factory becomes cold, the stain is chilled, the naphthalene has taken a notion to separate itself from the general mixture by crystallizing and settling. If this were not all, it might not be so bad, but it has such a peculiarity of taking other things with it. It removes a portion of the coloring material in various percentages; first, according to the amount of naphthalene present, and, second, depending upon the color itself. Some coloring material is more readily attacked and affected by the crystallization and the pre-

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cipitating process thus enacted than others.

This stain, which has gone through an ordeal of this kind, is absolutely changed. If the change be recognized, there is an opportunity for more doctoring. But the chances are that the stain will be allotted to the workman, and being thinner will penetrate deeper. This will help to retain the original color, but more likely the color will be found several shades lighter than it was intended to be.

OIL SOLVENTS SHOULD BE FREE FROM NAPHTHALENE.

Were this the only difficulty to be attributed to this series of solvents, and which I claim can be avoided by stipulating that this series of oil solvents be free from naphthalene, it would not be so bad. The one objectionable feature in the disposition of naphthalene is that it forms a coat of non-drying, oil appearing, waxy surface where the stain has been applied. It depends in great measure upon the kind of wood to which it is applied, to the amount of gas oil present in the stain, and the different solvents used in conjunction. The greasy, non-drying propensities of a gas oil stain often have been attributed to the stearic acid which is one of the constituents of oil soluble colors. But the truth is that the oil gave greater trouble, and that without its use there would have been sufficient penetrating material present to completely distribute the stearic acid in the pores of the wood.

TROUBLE IN "LIFTING."

Many a finisher has experienced trouble in the oil stains "lifting" when applying the shellac. This is often due to conditions as described above. The alcohol attacks the naphthalene and with it comes the colors and the attending troubles by the use of an oil stain in which a percentage of naphthalene is present. I do not condemn the use of this series of solvents; I merely draw out the difficulties that arise during cold weather. They can be avoided, and I trust that I have made it sufficiently clear so that the finisher will know and understand the means at hand to obviate the possibilities of trouble of this order.

A permanent finish never can be made where there is a large amount of this gas oil used. Understand me, I mean the gas oil as usually sold. To exemplify this, you have seen a house built where the shingles were

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stained and after a season there was hardly any color left. That was due to the naphthalene present in the creosote oil. Of course, had these shingles been treated as furniture is usually treated, the trouble would not have been so apparent, but there will be no permanent oil stain where the main solvent is one of these oils, unless you insist upon the same being free from naphthalene.

PERMANENT FINISH PREVENTED BY USE OF GAS OIL.

I have endeavored to emphasize these points, because many of you have used this material and have heard nothing of it after it left the factory. People are becoming more critical; they know there is a vast difference in the quality of finish, its durability and general appearance. The foregoing should help the reader to remove a possible danger and obstacle in attaining good results.

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CHAPTER XXIX.

SPECIAL ENGLISH OAK FINISHES.

THE average foreman is not located in the furniture center and, therefore, has not the advantage of his more fortunate brothers through the interchange of ideas. The assistance obtainable through coming in contact with the diversified methods of finishing afforded to those situated in the midst of an industry, he is denied. This chapter is written to give an insight into the methods and procedure usually employed in the making of these special finishes.

INSIGHT INTO METHODS OF SPECIAL FINISHES.

Jacobean is usually produced by the use of an oil stain. Its shade of a reddish, golden brown, with high light effects, has been pretty well standardized. The color can be readily produced by the use of a brown oil soluble color, which has a tint toward the orange. Usually an oil solution is made, or, rather, the color is dissolved in hot turpentine to which two pounds or more of black, preferably drop black, ground in japan, are added to a three gallon mixture. After the color is thoroughly established, the stain is applied with a fitch brush, but care must be taken not to apply it too heavily, for when it dries the stain darkens considerably. The high lights are produced by cleaning off the stain in the center of the panels, etc. It is entirely up to the foreman to get the effect. He must understand Jacobean effect and carry out the idea of the period. The design of the furniture usually helps him out. There is no difficulty in matching the color. A good golden oak oil stain will make a first-class base. A little experimenting with the application will make him proficient in that part of the procedure, and if in producing the high lights too much stain is removed, it is easily replaced, as the entire color scheme is produced before the finish is applied.

PRODUCING HIGH LIGHTS.

Kenilworth, which is very similar in appearance, is made by first fuming the wood. Load the fuming box at night and in the morning the wood will be suf-

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ficiently fumed to proceed. Then stain, using fitch brush, and allow the stain to dry 24 hours. This stain is practically the same color as that of Jacobean. The high lighting is done by using sandpaper and then dusting. Give one coat of white shellac, sand smooth and apply a flat finish. The selection of the color of this stain, and depth of shade, depends upon the Kenilworth that you are trying to produce. A golden oak oil soluble stain is usually used. But every foreman finisher knows that a good deal of his shade depends upon the amount of turpentine that is used in cutting the stain powder. To lay down a definite formula in this case would be the recommendation of certain makes of golden oak oil stain. The selection of this, therefore, is left to the finisher. If, however, he wishes to prepare his own golden oak oil stain, this can be done readily by taking oil black as a base and adding orange, yellow and red until the shade of golden oak desired is produced. It is not necessary to produce the shade of golden oak that is used in this, but better to produce the shade of color that you wish in making your Kenilworth.

KENILWORTH FINISH.

Another formula would be to dissolve oil black in turpentine and add it to asphaltum. This, however, would require more experimenting than to take the colors themselves, and would be apt to prove uncertain, as the different lots of asphaltum vary in color.

The finish known as Sixteenth Century is produced in a similar manner, with the exception of the fuming proposition, which is embodied in the production of Kenilworth.

16TH CENTURY AND STRATFORD.

Stratford oak is produced in a very similar manner. After the work is fumed a coat of dark brown is applied. When dry, a filler that has a slight pinkish cast is given, not with the idea of filling the wood but to give the pores a pinkish color. Then give two coats of wax.

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CHAPTER XXX.

BIRCH AND ITS VARIOUS FINISHES.

BIRCH, one of our well known native woods, is slowly but surely becoming recognized as a strong factor in wood industries. It has a good many qualities that are suited for cabinet work, notable among which are its strength, and that it gives a good surface and sands well. In finishing, the grain does not raise much, and the price also goes to give it consideration. It is the writer's opinion that, inasmuch as factories have undertaken the experimenting with this wood for furniture, its use will become large.

BIRCH AS A STRONG CABINET WOOD

Birch, as found in the market, is rarely quartered. There must be a reason for this, and there is a growing belief this style of sawing will be adopted as the demand for the wood increases, especially if it is to be employed in the better grades of furniture. For common and medium grades, it is most desirable, and if selected stock could be had, or the curly birch were plentiful, undoubtedly we would see more birch furniture.

I believe that the one peculiarity of this wood can best be explained in the word of a man who has had considerable experience with it. He says: "The only difficulty I have found in employing birch is the fact that often it seems to grow both ways; that is, when you look down a piece this way, the finish is elegant, turn it about and it is dark." This is due to the fact that birch often presents end growth, which is very susceptible to the stain, and, of course, will show up much darker than the rest of the work; not at all a pleasant feature when it makes its appearance in the center of a panel, or some large surface, for we all know that high grade furniture depends upon its uniformity of the wood in each individual piece. It is a question in my mind whether a good deal of this could not be done away with if the wood were quartered.

DIFFICULTY IN MATCHING BIRCH.

Birch makes an elegant wood for chairs. It takes

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finishes most beautifully. I believe a mistake has been made in the attempt to make a gray color for it to imitate gray maple, or the various grays that have been put on oak. The texture of the wood is not adapted for a good gray. The gray that can be produced may suit some people, but it will never be in competition with maple or oak for gray finishes. There is a certain vein in birch that when stained persists in giving a yellowish tone which clashes with the gray, and my experiments have shown that an entirely different line of endeavor should be employed for producing a finish that will help to popularize birch as a cabinet wood.

BIRCH NOT ADAPTED TO GRAY FINISH.

It has been put out as "fumed birch," and, considering the innovation, has been quite successful. The experiments that were made and the formulas obtained are quite interesting. Beautiful satiny brown finishes are quite possible, then if the laying of the wood is given sufficient attention so that similar grains and figures are joined together, the natural beauties of the wood will help to augment the general results. It has been found that the coating of the wood with a tannic acid solution, and when thoroughly dried with solution of bichromate of potash or bichromate of soda, which at this time is much cheaper, produces a beautiful and pleasing shade.

PLEASING SHADES ARE PRODUCED ON BIRCH.

Another formula, which is very similar to fumed oak, gives a good fumed oak color. By this color is meant the shade of brown that is now called "standard fumed oak." The first coat is made up of pyrogallic and tannic acids, one half ounce of each to the gallon; then, without sanding, a second coat made as follows is applied: Two ounces of dried carbonate of soda, one ounce of bichromate of soda in a gallon of water, to which is added ammoniacal solution of copper sulphate. This is made as follows: One ounce of sulphate of copper dissolved in eight ounces of water, to which is added 26 degree ammonia, until a precipitate is formed, and then continue to add the ammonia until this precipitate is redissolved. The ammoniacal solution of copper is added to the gallon of carbonate and bichromate of soda solution. This second coat

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is applied over the acid coat with the resultant brown, sanded slightly, and a very thin coat of white shellac applied, and waxed. The best velvety or satiny finish is obtained with a Circassian coat varnish, or a similar product. It is found that most any shade of brown can be made on birch; in fact, any stain that one may desire may be applied, but the idea is to get a color that will go with the trade.

BIRCH TAKES ANY SHADE OF BROWN.

There is more cheap and medium priced furniture made than high grade furniture, and the consumption by the public is far greater in number of pieces in these two named classes. Birch furniture made in popular designs, and supplied to the trade with a popular finish, such as its higher priced competitor, fumed oak, finds a good market.

Like mahogany, birch fills a certain place in the construction of some grades of furniture, especially in such parts where strength is desired, and so it has become natural for the manufacturer consuming birch in this manner to say that he wants a stain for birch. By that he means a stain that, when applied to the birch, will harmonize with the stain that he is putting on that portion of the piece which is made up of mahogany, whether solid or veneer. Now that brown mahogany is in vogue, it is only necessary to take the same material and apply it heavier to the birch, but it would be better to make a stronger solution for the birch wood. A great mistake has been that finishers will persist in filling the birch with the rest of the piece. This has a tendency to give the birch a muddy appearance. If you have a good penetrating stain, the color will be deep enough and the surface smooth enough so that filling is absolutely useless. Should it be that the stain does not take hold, add an ounce of acetic acid to each quart of stain. This will assist the stain to penetrate to such an extent that the color will be uniform and obviate the use of any filler.

BROWN MAHOGANY HARD TO PRODUCE ON BIRCH.

Undoubtedly brown mahogany is a finish that will be more typical of mahogany, and in consequence more difficult to produce satisfactorily on birch. That would be a reason for the production of a pleasing shade of brown and make it typical of birch. Gum, when

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slightly stained, and given a coat of orange shellac and dark varnish, produces a beautiful brown. It is a different shade of brown; it carries with it just enough originality to differentiate it from other woods, and therefore, in the making of a finish for birch, there is a possibility of striking a shade that will typify birch as an individual wood, which will later become popular in its own cast.

BIRCH MAKES BEAUTIFUL IMITATION OF CHERRY.

If curly birch were plentiful, the plain wood would not have to be considered now. That is not the case, and as long as we realize that birch is becoming a factor in cabinet woods, it is best at once to establish a finish for it. Birch will make beautiful imitation cherry. Care must be taken, however, not to give it a red tone, for cherry, when finished as it should be, has a very pleasing, mild color, due only to its own constituents. The trouble is, and has been, that in attempting to imitate cherry, the results have been too much on the red lines. A dark toona mahogany finish by some would be called a cherry when put on birch. The stain to be employed on birch to produce cherry, above all things, must be free from any sediment. It must be a penetrating stain, and made up of strong material so that a small quantity of stain powder will give the desired color.

BIRCH CAN BE FUMED.

It is not at all impossible to fume birch, but it does require a coat of tannic or pyrogallic acid, or a combination of both of the acids to produce a good fumed effect. Then, before a finish is put on, the wood is given a thorough oiling; this permitted to dry for 24 hours, or if a kiln is employed, 12 hours, then proceed with the regular finishing. Birch will give a beautiful fumed color. There is no more ideal wood for hotel furniture than this birch. It is durable, hard, and will stand and endure the rough usage to which hotel furniture is subjected.

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CHAPTER XXXI.

THE FINISHING OF AMERICAN WALNUT.

SINCE our native walnut has again become popular, the finisher is confronted with new problems, one of which is the correctness of the color in which this wood should be finished. One of the problems is due to the fact that manufacturers have bleached the wood, and this bleaching process has been carried on by different methods and to different degrees. We are just as much at sea relative to the correct shade for American walnut as we have been on many of the other new styles of finishes. Uniformity, of course, is almost a necessity. That nature does not produce her wares upon certain definite standards is unfortunate. Black American walnut varies the same as any other wood, but being a dark wood we find a greater amount of difference in the shade, probably due to the locality from which the tree was taken.

WHAT IS BEST FINISH FOR AMERICAN WALNUT?

In conversation with one of the best foreman finishers, he said that he did not know why walnut should be bleached, unless it is that some one, somewhere, ran onto some light wood and in order to match it, bleached the next piece, and in this manner the lighter shades became known and, of course, imitated. As long as a light shade of American walnut is supplied, the finishing department of necessity will be compelled to furnish the lighter shade, and to produce it with whatever means at hand. Should the tide of favor turn to a darker finish, it would be easier to meet the demands, as in that case it would require only the staining of the wood to the depth of the darker finish.

MAY BE USED BLEACHED.

I was shown some bleached American walnut that was of a lighter shade than Circassian, and it may be that the attempt is being made to bleach the American walnut so it can be used in place of Circassian. If a process can be simplified so that the work may be done in the finishing room, it may open one more avenue for the consumption of a native wood. This piece of

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wood was about one-fourth inch thick, and was bleached at least one-sixteenth inch, in fact, the color was much lighter than Circassian. The method just now is unknown, but we hope to be able to give it to our readers after further experimentation. What the manufacturer will call this bleached wood is a problem, and what there is to be gained by the introduction of such an extreme, remains to be seen. Woods mellow with age, and I cannot imagine anything more harmonious than a good rich, brown finish on American walnut. My conception for a finish for this native wood would be a rich brown, transparent color, with a Van Dyke filler, well cleaned off, two coats of oil, and varnish without shellac, rubbed dull. This would produce something that would have an air of elegance about it, especially if the design were commensurate.

ADVISES USE OF RICH BROWN WITH VAN DYKE FILLER.

Light colored woods, to the writer's mind, unless the design alone can produce it, will not give the lasting qualifications that a piece of furniture should have to bespeak refinement. It must be remembered in the finishing room that it is easier to match shades that are darker than the natural wood, than to attempt to match shades by a bleaching process.

The manufacturer alive to the situation will produce in his line something of the darker shades, and I am willing to prophesy that the darker shade will be the one that will find favor with the home furnisher. Hotels may desire the special bleached finish, which is another reason why American walnut designed for the home should be different than that turned out for public places. The production of the bleached finish is usually attained by first bleaching the wood with the several bleaching compounds that are at hand. Chlorinated lime, ofttimes misnamed chloride of lime, is a favorite bleaching agent. It can be purchased on the market in tin cans, the contents of which is diluted with water, and the work coated with this mixture. The chlorine gas retained is the bleaching agent.

HOW THE BLEACHING IS DONE.

A very efficient method, but which is now prohibitive owing to the price of material, is the use of permanganate of potash and oxalic acid or hyposulphite of soda. The potash is a purple chemical,

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giving first a purple color to the wood, changing to a brown. The bleaching is then accomplished by the second coat of oxalic acid. Oxalic acid is a white crystal, of which about a 5 per cent solution is required to overcome the permanganate of potash. A better, but cheaper, reagent for bleaching the permanganate is the hyposulphite of soda. This is an American product and can be bought for about three cents per pound. Unfortunately, it has little or no effect when applied by itself.

OTHER METHODS OF BLEACHING.

The use of peroxide of hydrogen gives very good results, especially if this material can be obtained freshly made, but it is rather expensive, yet very certain. A good stock solution to have in every finishing department is a solution known as chlorinated soda. It is a simple but efficient bleaching agent, and while not as rich in chlorine as the chlorinated lime, owing to its alkalinity, it has a peculiar effect upon the wood, which seems to give the small amount of chlorine present a greater opportunity for bleaching. Then, too, if first applied, followed with peroxide of hydrogen, a very effective bleaching process will be obtained.

There are a few chemical processes that will bleach wood, but it would be difficult to employ them in the woodworking industry. They may prove satisfactory in the laboratory, but not practical in the finishing room. After the wood has been bleached, the usual method is to give it a stain made up of walnut crystals, to which is added a small quantity of a solution of nigrosine and mahogany red. At best, this is a weak stain. The red gives it the warm tone that seems to be so desirable in the production of the present American walnut finish. The amount of real finishing on American walnut is rather scant, although the better grade of furniture seems to carry with it a little more varnish. It does seem a pity to take the elegant design and made-up pieces of furniture and send them out with a coat of shellac and a coat of inexpensive flat finish.

FINISH ON AMERICAN WALNUT IS TOO SCANT.

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CHAPTER XXXII.

STAINING WILLOW, REED AND CANE.

TO PRODUCE colors on willow, the operation must be divided in two distinct processes, coloring by immersing in hot liquids, or staining by applying the color in a liquid form; it not being our purpose to suggest the producing colors by painting or enameling.

TWO PROCESSES IN COLORING WILLOW.

In the manufacture of willow furniture, where a colored willow is to be produced, the willow usually is prepared by putting it through a bleaching process, which is subjecting it to the action of lime water, after which it is dried and found to be more susceptible to stains or colors, whether aniline or chemical, or a combination of the same.

The coloring of willow can be carried out better by applying the regular dye method than by attempting to produce a color by simply immersing in a colored solution.

The browns are the more desired shades, and undoubtedly those produced by chemicals are the more satisfactory. The formulas in which are given methods for the production of browns, by the use of permanganate of potash, bichromate of potash, pyrogallic acid, etc., when applied to the coloring of reed, will produce many shades of brown, the intensity of which may be augmented by the addition of aniline.

THE QUESTION OF VARIOUS SHADES.

The temperature has a good deal to do with the penetration, and should be kept at 150 degrees Fahrenheit, and the stain of such strength that excessive dyeing is not necessary, as a subsequent drying process will take much more time where the reed has been completely saturated in the dye bath.

Beautiful gray shades may be obtained by immersing in a solution of tannic acid and in a second solution of iron chloride, the strength of each producing the shade of gray. Where grays are to be produced, it is well to select well bleached reed, as the natural color of the reed does not give dainty shades of gray.

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Maroons, dark reds, and kindred shades may be obtained by the use of alkaline solutions of logwood. Two methods are used. One, to boil the reed in a strong solution of log wood extract and then passing it through a strong alkaline solution such as sal soda, which on account of its cheapness will be preferred. After the desired shade is obtained, care must be taken that the alkali is washed out thoroughly so that no detrimental after-effects are to be expected from the presence of alkali.

ALKALIES AND THEIR AFTER EFFECT.

The production of satisfactory results upon reed or willow depends upon the penetrating qualities of the stain. As experience has shown, this material does not take the color uniformly. The incorporation of acetone in small quantities, carbolic acid, acetic acid, or oxalic acid in their order named, will greatly assist the penetration of the stain. Certain cases will answer to the addition of a small bit of alcohol to the stain. An acid solution of an aniline may be found not to take hold at certain places, whereas, the addition of a small quantity of alcohol will prepare the way for the stain.

It is not necessary to enumerate specific formulas for the production of any stain. Suffice it to say that any aniline dye generally used in producing stain, the solution acidified, will produce the stain the shade of which is controlled by the material used. In cases where absolutely no results are obtained by the simple application of the stain, a fairly good color may be made by using spirit soluble colors, producing the shade you want and adding a pound of gum shellac to each gallon of such alcoholic stain. This gum will hold the colors in place and permit the subsequent finish to be applied.

SPIRIT SOLUBLE COLORS USED FOR SHADES.

Of late years it has become fashionable to stain; it really ought to be called coloring. Cane panels, etc., have become quite fashionable in modern furniture, and it is desirable to give this cane an harmonious color, a color that will conform with the style and general shade of the finish. It is practically impossible, owing to the glossy, hard surface presented by cane to stain it with any degree of uniformity or success.

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It has been found expedient, therefore, to prepare a mixture of colors, using the pigments ground in oil or japan in such proportions as will produce the shade in harmony with the finish of the furniture. The procedure is as follows:

HOW TO GET A MIXTURE OF COLORS.

Before applying any color, give the cane a coat of japan, being careful not to allow an excess to be applied. This coat forms a body upon which may be spread uniformly the color coat, made up of japan and for the colors of umbers, siennas, etc. This coat must be thin, and carry merely enough body to uniformly spread the color, it being advantageous to repeat the operation rather than to attempt to put on a heavy coat. The final finish may be obtained by using a flat, or Mission finish.

There is no established standard for this work and each artisan will have to work out his own salvation, where confronted with work of this kind.

The use of a bit of varnish with the japan and pigment coat may be found necessary, but whatever is applied, it should be short on oil, and quick-drying. The work must not be gone over, as that has a tendency to lift the pigment from one place and to deposit it on another.

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CHAPTER XXXIII.

BROWNS FROM TANNIN AND POTASH.

ON application of one to two ounces of tannic acid dissolved in a half gallon to a gallon of water to oak or many of the other cabinet woods, and after sanding apply the piece in warm solution of two ounces bichromate of potash or soda, and raising to a temperature of 100 to 125 degrees, there will be produced by the aid of the carbonic acid gas in the air, beautiful brown tints, all of which may be varied according to the strength of material employed.

GETTING TINT DEPENDING ON STRENGTH OF MATERIALS.

This process will produce pleasing shades on gum, pine, and other soft woods. On soft woods it has the faculty to bring out the figure, the flakes producing a more attractive coloration than an aniline stain, the surface having the appearance and the effect of a distinct coloration of its fibers, especially the flakes. The effect is of greatly enhancing the characteristics of the particular growth of each wood.

In applying this method to hard woods, care must be taken to obtain uniform application so that no blotchy work may result. If it is desired to obtain a more reddish brown cast, this may be done by adding pyrogallic acid to the tannic solution. It is well to prepare the acid solution fresh when desired for use.

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CHAPTER XXXIV.

BROWNS FROM POTASSIUM OF PERMANGANATE.

POTASSIUM permanganate is a violet crystal, and its stain qualifications depend upon its peculiarities of producing brown shades when it comes in contact with organic substances, or on exposure to the air.

THE WORK OF COLD WATER STAINS.

The solution should always be prepared with cold water. The application of this stain should be made with a sponge and not with a brush, as the bristles will not withstand the action of the permanganate. When first applied to the wood, it will give a violet shade which will gradually turn to a nut brown, and of a depth in direct ratio to the percentage of permanganate employed in the solution. Where a deep brown shade is desired, a second coat will usually produce results.

The use of permanganate is a very handy method for producing brown, particularly where it is desired to match some other finish, as in the case where too dark a shade of brown may have been produced; it may be lightened in shade by the sponging with any mineral acid, or solutions of sodium hyposulphite. This method will be recognized as the same as that given under Bleaching, and often taken advantage of for the imitation of inlay wood, accomplished in the following manner: After the entire piece has been stained brown, paste strips of paper to the surface, leaving such parts exposed which should represent the inlay; then treat this exposed surface to the action of hyposulphite of soda, when an absolutely white wood surface will be obtained. Then the paper is removed by laying wet cloths or blotters thereon, which will soften the adhesive and permit the paper to be taken off. Lightly sand, and it is ready for the regular finishing work.

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CHAPTER XXXV.

FADS AND FANCIES IN FINISHES.

SINCE the introduction of the Gift Shops, stores that usually offer the unique, and things out of the ordinary, there is being created a demand for small odd pieces suitable for gifts. The workers have taken advantage of silver gray, kaiser gray, and several other grays, making the goods mostly out of oak. Probably no wood offers the possibility of a larger variety than oak. By taking advantage of its beautiful flake, and large pores, staining the wood, and producing a contrast effect by filling the pores with various pigments, there can be produced an endless variety of pleasing and attractive effects. In order to get the best effects by the introduction of the various fillers, it becomes necessary to have a comprehension of the stain materials employed.

OAK ADAPTS ITSELF TO NOVELTIES.

For instance, it is an easy matter to color the wood, and then to put some radically different color or filler into the pores, but that does not accomplish the artistic effect, nor that pleasing soft tone which will go a long way towards making a piece of furniture or a novelty fascinating. On the contrary, the more one studies a creation of this sort, the less it gains in favor. The ground work must be stained so that the flake surrounding the large pores will take on a correspondingly definite color—a color which is in harmony with this filler; a color which in turn is to produce a contrast that at once makes it attractive and pleasing to the eye. It is, therefore, necessary that the stain present a sharp contour about the flake, and be softened down to the center of the flake, leaving the appearance of a clear surface.

Naturally one would select for this purpose quarter sawed oak, so as to take advantage of the characteristics of the wood. The wood should be sponged to raise the pores, and then thoroughly sanded. If the pores are not sufficiently opened by this process, the result

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desired can be accomplished by going over the work with a picking brush, and thoroughly dusting it off. Then the stain is applied, and this should be done thoroughly. The application of a stain cannot be called thoroughly applied if the wood be simply covered and colored. If a depth of color is to be produced it is better done by the application of two weak coats, than by one strong coat. There will be less danger of cutting through when sanding, for the simple reason that these fancy finishes are seldom more than shellaced or waxed.

OAK PERMITS OF ARTISTIC COLORING.

Oak presents an almost unlimited amount of possibilities for artistic colorings. Especially do the chemicals aid us in producing absolutely permanent stains. This is fortunate, especially in finishes, where the protecting coats, such as two or three coats of varnish, are not used, but instead a thin coat of oil and a bit of wax. The following classification will assist those who may be called upon to produce these color effects. The filling is made an after-treatment, but the similarity of procedure makes it possible to cover all cases in a few paragraphs, and will be given in a separate list.

First—By the use of iron, as iron sulphate or iron chloride, in its various dilutions, grays can be produced in any depth of color. The color may be evened up by penciling with a weak solution of tannic acid.

Second—Rich browns can be produced by boiling catechu and bichromate of potash, and applying the stain, one or two coats.

CLASSIFICATION OF COLORINGS.

Third—The Persian brown by applying a solution of permanganate of potash, permitting it to stand six or eight hours, when the second coat should be applied.

Fourth—Old Oak—To each pint of water add one ounce of carbonate of potash (salts of tartar). When dissolved, mix with an equal quantity of ammonia water. Stain the wood, and let stand for 24 hours. Then apply a solution of sulphate of iron, one ounce to the gallon of water. This will produce, according to the strengths employed, a great variety of oaks. The process may be carried until darkest shade of brown is produced.

Fifth—Bichromate of potash gives yellow tints; if carbonate of potash be added, lighter shades of brown.

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Sixth—The application of pyrogallic acid, one ounce to the gallon. This can be applied to the sponging coat. The second coat made of one ounce of nigrosine to the gallon of water, and if a deeper brown is desired, add a small percentage of the iron sulphate solution.

Seventh—The application of a tannic acid solution and a subsequent coating with logwood extract, which has been dissolved in hot water, and to which has been added a 5 per cent solution of sulphate of copper.

TEN SHADES AND MANY VARIATIONS.

Eighth—Any aniline color that will produce a staple green, such as acid green, applied to the strength of the desired color, and then coated with a 5 per cent solution of picric acid.

Ninth—Acid green solution, sulphate of iron solution, nigrosine solution, to produce the deep and olive green.

Tenth—Acid green, picric acid and sulphate of copper, of sulphate of iron to produce gun metal effect.

In giving the above, let it be distinctly understood that the finisher can vary his shades according to the strength. But the key given will produce absolutely transparent, penetrating and fast to light colors. Each stain will affect the flake in such a manner as to be co-ordinate with the filler.

In preparing the fillers for these kinds of finishes, it is to be expected that they will be made of harmonious tones. The gray, from a light shade of gray which will be filled with white filler mostly, and which, according to taste, can be darkened with drop black; the browns, in contrast with the shade of the wood; the greens mostly made by coloring the ordinary filler with chrome green and darkened with drop black. But where the correct shade of green cannot be produced by the use of chrome green, color the filler by the use of ultra-marine blue, and chrome yellow, and getting it dark enough by the addition of black.

FILLERS MUST BE OF HARMONIOUS TONES.

One of the most beautiful effects produced and which has not been taken up in our country to any degree, is gun metal, so called because a metallic effect is produced by the filler, which is made up of oxide of lead, commonly known as plumbago or graphite. This filler coating should have enough japan to hold it, as

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when it is applied it is more difficult to hold in place than any of the other pigments. It should be used in a very fine powder, so that in applying it to the wood, a small amount of it will be drawn out of the pore and blended over the flake, which will then produce the gun metal effect, but still bring out the beautiful flakes of the oak.

GUN METAL A BEAUTIFUL EFFECT.

The many novel shades and finishes that can be produced on maple and oak are finding their way slowly but surely into the market. Especially are these woods and finishes popular in the finishing of cafes, lobbies, store fixtures, window decorations, etc. France is buying our bird's-eye maple. In that country the most delicate shades are produced, especially in the gray. The tensile strength of the wood admirably adapts it to many of the dainty lines put out by the French manufacturers. The satiny finish afforded by French polish still holds forth in some of their markets. The traditional clannishness clings and the impress of the Louis periods furniture, we are told, has a preference there, rather than the heavy lines of our Mission. The French get more out of a board than we do. It is only to be expected that the same daintiness of color would prevail.

With maple there are various ways for the production of the color. At one time, the wood could be purchased already colored, but for the occasional production of this color on maple, nigrosine, jet black, paper black, anilines are the series which will make a fairly good gray. These are all water soluble, and should be applied hot. It will be found that, when applied cold, the color will have to be put on so sparingly in order to produce a light gray that the yellowish tint of the maple will show, and an uneven color will be the result. Only a very little color to the gallon of water is required. Were it not for the fact that the spirit stain fades, it would make a better gray. A very pleasing and, undoubtedly, the best results are obtained by the use of iron salt in conjunction with a good permanent black aniline. For the finisher to have a uniform result, one to be relied upon, a certain amount of precaution is necessary in the use of the iron. Sulphate of iron

MAPLE OFFERS VARIOUS WAYS OF COLORING.

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is not a staple salt and, therefore, in using it, it is better to buy the dried sulphate of iron rather than the crystal, or, if this is not at hand, to purchase the solution of chloride of iron which is of definite strength. The shade to be produced is then merely a matter of quantity.

HOW BLUISH CAST MAY BE OBVIATED.

To avoid the bluish cast which is sometimes apt to result from the use of the iron and the nigrosine, a bit of orange should be used, and will overcome it. All shades of gray can be produced in this way. The fine grain of the maple makes it necessary that the finish be of an absolute uniformity of shade. The heart of the maple tree cannot be used in the making of a piece of furniture, as its brown shade cannot be overcome by so delicate a color as gray. It cannot be bleached satisfactorily, and when it does appear in the made-up piece, it would be better to stain it as an imitation mahogany.

After the stain has been applied, it should be allowed to stand at least 24 hours; but, better yet, 48 hours. Then let it be sanded with very fine sandpaper, and polished with paraffine wax. This wax is best applied by melting it and thinning with a substitute turpentine such as turpaline, or terrabentine, which has no color. It can be obtained easily by demanding the pure article. This substitute is placed on the market in such a manner as to give it the physical appearance as well as odor of the genuine turpentine. This is done by adding a quantity of regular turpentine, sometimes a bit of rosin, and fire-weed oil. None of these, however, are wanted in the solvent used to thin the wax. After the wax is applied, let it stand, then bring it to a polish, and the second day after it has been polished, rub in a circular manner, the same as French polishing. The finished work should have a satiny appearance. Lacquer takes the place of paraffine wax, but it will not withstand the usage. It would be better to put a thin coat of lacquer on the stain coat, and the wax on it. This, however, is a matter to be considered in cost of production.

FINISHING OF MAPLE.

Maple is used as imitation cherry, and works up beautifully for that. It is also used as imitation mahog-

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any and in various other ways where the strength of the wood recommends it.

Among the novelties—but always made on oak—are driftwood, Kaiser gray and silver oak. The latter, however, is not a regular gray, but still must be classified with the grays owing to its style of finish. On oak a gray can be produced in the same manner as on maple. The stain, however, must be carefully used. Avoid lapping of brush marks, and give it plenty of time to take on its shade. The iron salt, with the tannic in the wood, produces the color to a certain degree, and the stronger the stain, the deeper the color. The nigrosine serves to modify the shades and to kill the blue cast. The difficulty is the fact that the different pieces of wood put in the make-up of the furniture contain different percentages of tannin and, in consequence, one is apt to obtain as many different shades as there are pieces of wood.

NOVELTIES ON OAK.

If it were possible to make a table top or any surface out of one board, this difficulty would not arise. Knowing how to produce a color should help us to know how to make it uniform. When it is found that right through the center of the stained piece there is a light streak, it can be matched up by taking a solution of tannic acid and coating the work and then, when dry, applying successive coats of very weak stain until it has taken the depth of color to match the balance of the piece.

RUSSIAN BROWN.

Another attractive novelty is known as Russian brown, a beautiful light brown, which is sometimes utilized in the bird's-eye maple, with the eye taking a darker tinge.

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CHAPTER XXXVI.

BLENDING WOODS A DIFFICULT PROCESS.

THE usual procedure for the blending of golden oaks to uniform the colors and shade, due to the difference in the texture and kind of the woods, is a problem that confronts every manufacturer in the woodworking industry.

BLENDING BEFORE FINISH IS STARTED.

The most reliable remedy is the blending of the shades before any finish is attempted. This, however, is rather difficult, and should be attempted only after considerable experience has been had, and the workman becomes familiar with the general scheme of equalizing shades.

In golden oak, where the difference in shade is brought out after the stain and filler coats are applied, proceed as follows:

Prepare a weak stain by the use of oil black, oil brown and oil yellow, the shades of which are exemplified in the colors. Make three distinct solutions, one ounce of color to the quart of turpentine. Of these three solutions, use a sufficient amount of each to produce a light stain, but of the same tone as that of the present appearance of the work; that is, the appearance of the stained and filled work. Apply cautiously with the use of a camel hair or a fitch brush to the light parts, applying repeated coats until it presents the same depth of color of the darker. When uncertain, have a bit of naphtha at hand, and wet the dark portions which you are trying to match so that both pieces can be judged when wet.

For cases where the piece of wood runs from a dark shade to a very light shade, usually on extremely hard pieces of wood, it will be found that the darker piece is a softer piece of wood, that it may run upgrain, presenting more of the pores. Consequently a good deal more of filler has been taken on. Here it is best to grade down the shade, from the dark edge to the light, reducing the amount of difference gradually.

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This is usually done by making a brush that will greatly assist, as follows: Cut the hairs diagonally, so they will be short on one side of the brush, and full length on the other, then chisel them down so that the long hairs will be full thickness, and thinned out to the short side of the brush.

HOW TO MAKE A BLENDING BRUSH.

You will find that a brush of this kind will carry a full coat of stain in the long fibers with a gradually diminishing amount of stain in the thin and short fibers, and that it will deposit its color material in a similar proportion. The workman in this way will soon learn how to spread the color and the brush will save a good deal of time, as the one dipping will deposit the most stain where it is required. You can readily see how you will take the light piece of wood, where it shows the extreme difference, and grade it out. It might be well to mention here, that on the cheaper woods, the simple reduction of your asphaltum with turpentine and naphtha will make a good blending stain; always bearing in mind never to have the stain strong enough so that a complete match could be made with one stroke of the brush, as in that case you would be very apt to find the blending work going darker than that you are trying to match.

A BLENDING BRUSH

REDUCTION OF ASPHALTUM MAKES GOOD BLEND STAIN.

The strength of the stain rather depends upon the aptness of the workman. It should be thin enough, and a sufficient amount of naphtha used to insure quick drying so that the repeated coats can be applied with-

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out the stain acting in the capacity of a varnish remover. In that case, it would not only lift the stain originally applied, but it would also lift the filler, and would then cause an uneven deposit with the result that the work would have a mottled appearance.

For the use of a water stain, it will be found that this will work very nicely, provided sufficient amount of time has been given for the original coats to dry. The ordinary workman will belittle the application of a water stain on top of a filled piece of wood, and he will tell you that it cannot be done. Proceed as follows:

STRENGTH OF STAIN DEPENDS ON WORKMAN'S APTNESS.

The water stain will not lift or open any of the pores. In short grained wood or cross grained wood, where the stain takes dark, where a lot of filler is consumed in the filling, a difficulty can be avoided by first shellacing this coarse part with a very thin coat of shellac. This will hold back the stain coat and at the same time hold back the filler, so that when the piece is ultimately finished, a uniformity of shade is the result.

A blending mixture recommended for the use of fumed oak and which can be applied with a brush, described in this chapter, is made up as follows:

To a pint of alcohol, add a half ounce of Bismark brown, spirit soluble. To another pint of alcohol, add a half ounce of spirit black, alcohol soluble. When the solution of each is complete, pour each solution into a pint of white shellac and shake them up thoroughly, enough of the Bismark and enough of the black, to obtain the proper tone for blending, until it produces the correct shade desired on the fumed oak. For instance, if sapstreaks are encountered and are very light, this blending solution must be proportionately darker. This same solution is good to be used in the covering of the edges where the sanding has cut through, as the small amount of shellac will hold the color to place and obviate any danger of finger marks or prints in the handling of the work afterwards.

WATER STAIN ON FILLED WOOD IS PRACTICAL.

Blending on gray is seldom required, but when required, a black shellac solution will do. If, however, it is required to be used on gray maple, silver gray,

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or any of the very light shades, a very small amount of black is better. In other words, it would be better to make an alcoholic solution of the black or even a water solution of nigrosine black and touch up the work, and thus avoid the extreme polish that would be obtained if a shellac solution were used.

BLENDING MIXTURE FOR FUMED OAK.

Not much blending is done on mahogany. The only touching up that is required on this finish is usually from troubles caused from sanding through the finish. In this case the Bismark brown solution will answer the purpose. Where the brown mahogany is used, produce the brown by the use of Bismark brown and spirit black solution and adding a bit of orange until the correct shade of brown is obtained.

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CHAPTER XXXVII.

BLEACHING WOOD BEFORE STAINING.

THERE are numerous ways of bleaching dark spots and discolorations on wood, but the method which will perhaps give the most general satisfaction is the oxalic acid bleach. For this bleach one half pound of oxalic acid crystals should be dissolved in a half gallon of hot water. This solution should be applied to the wood with an old brush, and when dry the surface should be gone over with clear, hot water. Often repeated applications of the bleach are necessary. Should this be the case, the wood should be washed off with hot water only after the final application of the bleach. When the wood to be bleached is greasy or oily, it should first be washed with alcohol or benzine, to remove all the grease; when the wood is dry, the bleach should be applied.

OXALIC ACID BLEACH FOR DARK SPOTS.

A good stock solution to have in every finishing department is a solution known as chlorinated soda. It is a simple, but efficient, bleaching agent, and while not as rich in chlorine as the chlorinated lime, owing to its alkalinity, it has a peculiar effect upon the wood which seems to give the small amount of chlorine present a greater opportunity for bleaching. Then, too, if first applied followed with peroxide of hydrogen, a very effective bleaching process will be obtained.

Chlorinated soda solution may be made as follows: Take 21 ounces of sal soda, and dissolve in 40 ounces of hot water. This is Solution "A." Take 10 ounces of chlorinated lime and mix it with one and one half pints of water. Stir this mixture thoroughly; then allow it to settle, and pour off the clear liquid. To the sediment, add another pint and a half of water and repeat the operation. After this second solution has settled, pour off the clear liquid into the other solution and to the sediment add a bit more water. Let this filter into the balance of the chlorinated solution. Pour the two solutions together; the result will be a clear,

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pale greenish liquid, having a faint odor of chlorine, and a disagreeable alkaline taste.

REMOVING IRON SPOTS.

Iron spots may be removed with a solution of cyanide of potash, phosphoric acid, and then washing off with clear water. Sulphur fumes will bleach and, while difficult to apply, will ofttimes do the trick by blowing the fumes against the part to be bleached, covering the work with a 2 per cent solution of permanganate of potash, and after it is thoroughly dried, applying a 5 per cent solution of hyposulphite of soda. This method has been found very satisfactory, especially in the softer woods. Care should be taken in all cases to remove the chemicals from the wood by repeated applications of fresh water.

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CHAPTER XXXVIII.

EBONIZING BIRCH, MAPLE, BEECH, ETC.

THE WOODS best adapted for ebonizing are apple, pear, hazel, maple, beech, and birch, in their order named. When stained black, they give the best imitation of the natural ebony. The process is best carried out by immersing or by applying repeated coats of the hot color material. Aside from the method given elsewhere for ebonizing laboratory tops, the formula here given will produce very satisfactory results.

WOODS THAT IMITATE EBONY WELL.

For staining, boil one pound of logwood chips in two quarts of water, or one ounce of logwood extract (solid). Brush the hot solution over the work, giving it a second coat when dry. Allow this to stand at least 24 hours, and then coat with a solution of one ounce of green copperas (sulphate of iron) to one quart of water. Let this dry in a warm, well lighted place. It should not be hastened by artificial heat.

For dipping, the solutions may be prepared practically as given above, and the woods immersed for at least 15 minutes in the first solution, then drained off and allowed to dry in a good circulation of air; immerse in the second solution, which may be made up of sulphate of copper in place of sulphate of iron, taken from this solution, and again dried, and passed through an alkaline solution made up by dissolving one half pound of sal soda in a gallon of water. After it passes through the third solution, it should be rinsed in clear water.

POLISHING IMITATION EBONY.

For polishing imitation ebony, such as piano keys, etc., first coat the work with a very fine glue size, and when dry smooth lightly with No. 00 sandpaper. Do not cut through the stain coat. Then make a pad, and apply French polish; immediately add a few drops of oil, and rub with a circular motion. Set it aside for one hour, sand again lightly, and repeat the operation.

To spirit off, great care must be taken or the work will be dull instead of bright. Take a clean pad, moisten

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with alcohol, passing quickly over the surface; then drop on a few drops of oil, and rub lightly but quickly in circular sweeps until polish is obtained.

EBONIZING LARGE SURFACE.

For large surfaces, similar methods may be employed, but good effects can be produced by oiling the work, giving it at least 48 hours to dry; then two coats of shellac, and rub dull with oil.

For formulas for ebony stains see chapter on Stain Formulas.

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CHAPTER XXXIX.

GETTING COLOR RESULTS WITHOUT ANILINES.

THE production of wood stains is not solely dependent upon the aniline dyes, and to familiarize the finisher with the possibility of employing chemical and vegetable extracts is the object of the following tabulation of the more popular materials which are in use and which can be employed to great advantage. Every one has been tested and is thoroughly reliable. The tables show at a glance how to combine chemicals and colors to produce a given stain.

HOW TO OBTAIN CERTAIN STAINS.

These are valuable suggestions, but by no means do they embrace all of the possibilities, for by the use of these as a base, where the reaction is acid in nature, acid colors or anilines can be added to the chemicals, which then act as a mordant for making color permanent and, at the same time, play a part in producing the color.

To make this absolutely clear, such salts or chemicals as potassium chromate, sugar of lead, magnesium sulphate, and the various acids will combine without injury to color with any of the acid colors in the aniline series. Alkalies will destroy the color of many of the anilines. We, therefore, do not recommend their use in combination. They will work with basic colors, but as the basic color is not considered fast to light, without a second coat of some mordant, they are seldom used in connection with the color. Where the effect is that of an alkali, under which head comes carbonate of potash, aqua ammonia, sal soda, etc., these should be used in a coat by themselves, and after it is dry, the other color put over it.

USE OF ALKALI NOT RECOMMENDED.

It is true that a good many use a small amount of potash in getting their mahogany stain. It is a question whether this is absolutely wise. It is done with the belief that it helps the color to penetrate the wood; but, in the writer's mind, this potash is more harmful than beneficial, and he recommends the use of bichro-

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mate of potash, which not only gives a color, but helps to fasten the stain in the wood

A few experiments will exemplify the method and results obtained. Oak would not be expected to produce the same shade as mahogany, etc. The decoctions of various color-giving woods are not without their uncertainties. This is due to the fact that a vegetable is not always uniform in its color-giving proclivities and, therefore, after producing a uniform extract, it is well to keep a sample of it for future operations. This fault is being met by the production of extracts made from these various color-giving plants which are as nearly uniform in their color value as possible to make.

DECOCTIONS NOT WITHOUT UNCERTAINTIES.

The table which follows has been published in many periodicals, trade journals, etc. It will serve a purpose here, as heretofore many formulas also have been published, giving the use of these and other vegetable coloring materials which today are not considered, nor being recognized. The list shows at a glance what is to be expected and the possible results that may be obtained by the use of the ingredients so treated.

WHAT VARIOUS COMBINATIONS PRODUCE.

Decoction of logwood treated with:	Gives:
Strong hydrochloric acid	Reddish yellow
Dilute hydrochloric acid	Reddish orange
Pure and diluted nitric acid	Red
Pure and diluted sulphuric acid	Black
Sulphide of hydrogen	Yellow brown
Ferric nitrate	Black
Potassium chromate	Black
Stannous chloride	Violet
Tartaric acid	Gray brown
Sulphate of copper	Dark gray
Tannin	Yellow red
Sal ammoniac	Yellow
Verdigris	Dark brown
Sugar of lead	Gray brown
Potash	Dark red
Potassium permanganate	Light brown
Potassium iodide	Red yellow
Cupric chloride	Reddish violet to dark brown
Chrome yellow	Dark violet

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Soda	Violet
Sulphate of iron	Gray to black
Alum	Dark red brown
Carbonate of potash	Yellow brown
Magnesium sulphate	Brown
Cupric nitrate	Violet
Aqua ammonia	Dark violet
Potassium sulphocyanide	Red
Zinc chloride	Red brown

Decoction of fustic extract treated with:	Gives:
Concentrated hydrochloric acid	Red
Dilute hydrochloric acid	Yellow brown
Concentrated nitric acid	Reddish yellow
Dilute nitric acid	Brown
Concentrated sulphuric acid	Dark purple
Dilute sulphuric acid	Brown red
Aqua ammonia	Dark yellow
Ammonium sulphydrate	Dark yellow
Ferric nitrate	Dark gray yellow
Tannin	Yellow
Potash	Yellow
Stannous chloride	Yellow
Cupric chloride	Yellow
Tartaric acid	Yellow
Alum	Yellow
Pyrogallic acid	Yellow
Cupric sulphate	Orange
Sugar of lead	Yellow
Potassium permanganate	Brownish yellow

MANY YELLOWS PRODUCED.

Decoction of Brazil-wood treated with:	Gives:
Strong nitric acid	Dark purple
Dilute nitric acid	Pale red
Strong sulphuric acid	Red
Dilute sulphuric acid	Red
Strong hydrochloric acid	Dark red
Dilute hydrochloric acid	Light red
Aqua ammonia	Dark red
Ammonium sulphydrate	Dark red
Sulphide of hydrogen	Light red
Sulphate of iron	Dark violet
Tannin	No change
Stannous chloride	Light red

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Cupric chloride	Dark red
Sal ammoniac	Reddish yellow
Sugar of lead	Yellowish red
Potash	Dark crimson
Tartaric acid	Reddish yellow

Decoction of madder treated with: Gives:

Dilute hydrochloric, nitric or sulphuric acid	Pale yellow
Sugar of lead	Reddish violet
Soda	Red
Tartaric acid	Pale yellow
Tannin	Pale yellow
Potash	Light red
Sal ammoniac	Pale yellow
Aqua ammonia	Reddish yellow
Alum	Faint red
Stannous chloride	Light red

FURTHER INTERESTING COMBINATIONS.

Decoction of French berries with: Gives:

Dilute hydrochloric acid	Rose color
Dilute nitric acid	No change
Dilute sulphuric acid	Yellow
Potash	Yellow
Stannous chloride	Dark yellow
Tartaric acid	Doscoloration
Sugar of lead	Dark yellow
Ammonium sulphydrate	Faint yellow
Potassium bichromate	Brown yellow
Ferric nitrate	Dark olive green
Potassium iodide	Yellow
Cupric sulphate	Greenish yellow

Decoction of tumeric treated with: Gives:

Hydrochloric, nitric or sulphuric acid	Yellow
Sulphate of iron	Greenish yellow
Ferric nitrate	Yellow to dark yellow
Sugar of lead	Yellow
Alum	Yellow
Potash	Red yellow
Stannous chloride	Yellow
Sodium	Yellow

The foregoing table is obviously of great importance in the finishing room.

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CHAPTER XL.

THE STAINING OF DRAWERS.

THE difference in the cost of finishing the inside of a suite, and the cost of doing it right, is so small as to make it scarcely worth while speaking about. There is no good reason for staining the inside of furniture darker than the outside, and it costs more to do it that way. To make a pleasing contrast when the drawers are opened the inside should be stained considerably lighter than the outside. Everything else being equal, this gives the goods a touch of refinement that appeals to the aesthetic taste. I cannot understand why so many leave the outside of the drawer sides unfinished. Of course the slides ought not to be varnished, but they should be stained to match the rest of the drawer and given a thin coat of shellac. A great many factories are doing this now, but sometimes a trimmer finds it necessary to plane some off the slide to make the drawer work freely and frequently it is left that way—part finished and part white. It should be somebody's business to see that this patch is repaired; it should be the duty of the trimmer either to repair it himself or see that it is done.

STAINING DRAWERS ADDS REFINEMENT.

No matter how the outside of the case is finished, whether polished or dull, a gloss finish on the inside is an offense against good taste, and tends to cheapen the appearance of the whole thing. A dull finish is the proper thing. Some factories dull rub the inside of the drawers; but this involves a lot of work, and unless the oil is thoroughly cleaned out of the corners—which is not always the case—the effect is anything but pleasing. There are on the market flat drying varnishes that are not very expensive and which make an excellent finish for the inside of case goods. Some of these are harsh to the touch when dry, and some are soft and velvety. Of course the latter is preferable.

DULL FINISH IS THE PROPER THING.

A good finish for the inside of drawers may be made as follows: Take 20 gallons of water heated to about

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175 degrees Fahr., dissolve in this eight pounds of borax. Then pour in slowly, stirring constantly, 40 pounds of orange shellac. Stir until all is dissolved. This makes an excellent drawer finish, but where the goods are to be water rubbed it should be put on after the rubbing has been done, as it will not stand water. It should be used merely as a finish coat on top of a coat of spirit shellac. Spirit shellac for inside of drawers should be made somewhat heavier than is used for ordinary work. Three and a half pounds of gum to a gallon of solvent will be about right on work that has been water stained. This should be nicely sanded before the finishing coat is applied.

GOOD FINISH FOR PURPOSE.

When drawer bottoms are faced with mahogany, walnut or some other open grained wood, these should be filled before they are put in the drawer. When staining the drawers, the bottoms may be stained over the filler and wiped off with a rag. This will give them sufficient color to match the sides.

There are makers of furniture who think it is of no importance how the back of the case is finished. This is a mistake as regards the better grade of furniture. Everything is of importance. No one pretends that the back should compare with the front, but the contrast should be pleasing. The back should be finished like the inside—clean and smooth and dull. The shellac finish above mentioned may be used on the back with good results.

When using this shellac finish do not work it too much or it will froth. It requires merely enough brushing to spread it over the work and will flow out nice and smooth of itself. It should be strained through book muslin to remove foreign matter that one finds in the gum, and to insure a nice smooth surface.

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CHAPTER XLI.

CHANGING FINISHING STAIN SHADES.

IT SHOULD go without saying that the needs of different factories are not the same, and that therefore the requirements of the finishing room are not all the same. The factory that depends upon the ready made stains has really but two essentials to look after. One of these is to see that the stain is always uniform and the other to get the best for the least possible money. After the shades have been adopted, it is up to the foreman to see that the stains are uniformly applied, and that he gets the greatest amount of work possible per hour. It is like a painter who buys ready mixed paints, stirs them up and spreads them. He buys them from a color card and suits his customer from this color card because in that way all he has to do is to open the pails and apply according to the directions. But should the customer wish the shade changed a little the painter would be up against it unless he knew just a little about the mixing of paints. And unless he understood something about the paint he was using, he might ruin the paint in his attempt to alter the color.

TWO ESSENTIALS IN READY MADE STAINS.

It is not my province to talk against the prepared material. This is unquestionably as good as can be made, but cases continually arise in which it becomes absolutely necessary to change the shade, and it is here that it becomes imperative to have such knowledge of the material as will enable the foreman to add colors to his prepared stains in order to change the shade. If, therefore, he has a fair amount of knowledge of what is usually employed in producing a desired result, he can do this without spoiling or injuring the stain.

CONSTANT NEED OF CHANGING SHADE.

There are all kinds of goods on the market—water stains, oil stains, and spirit stains. The maker of each lauds the special qualities of his make. Unquestionably in the main the claims are correct. It remains for the manufacturer to select what is best adapted for

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his purpose. There are some places where nothing but a spirit stain is advisable. There are other places where only water stains can produce the desired effect, and lastly spirit stains, which serve best for a special purpose.

COLOR VALUE HIGHEST IN WATER STAINS.

The color value is highest in water stains, for two reasons. A greater variety of colors are made water soluble, permitting the production of a greater variety of colors or shades, and these are of more delicate hues. Again the material upon which we are working, namely, wood, in its growing state has a water soluble sap, so that when a color is applied it stands to reason that if it be mixable in the same fluid as that which had been a component part of the wood, it is going to unite better than if applied by a vehicle absolutely foreign to the nature of the product to which it is applied. Second, oil stains, because they save time and labor, and will produce a satisfactory color. But as yet the colors obtainable are limited. Third, spirit stains which are not, however, as a rule permanent when exposed to light. It is a peculiar fact that wherever the highest grade furniture is made you will see water stains predominating. There are places of course where the oil stains are used in conjunction with water stains; places where it is absolutely necessary not to raise the grain. This applies also to spirit stains.

WATER STAINS IN ANY SHADE.

An intimate knowledge of the stains, and the production thereof cannot be expected to be had by the foreman finisher. His business is the using of the material and the getting of results. It is also his business to get the best results for the least expenditure of money and labor. His requirements, therefore, are governed by the class of goods, or furniture, turned out in his particular factory. But the more he knows about stains the more readily he can adjust any difficulty with which he may be confronted.

For water stains the following colors will produce any of the shades now on the market: Black, brown, orange, red, and yellow. For the blacks, nigrosine or naphthalene black; for the brown, Bismark, loutre, and seal; for the brown mahogany, orange and naphthalene black; for the reds, scarlet, or carmosine. For the

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orange there are but two shades—orange Y and orange G; in the yellow, naphthalene yellow and aurimine. With these colors any water stain can be made or altered.

In oil stains the same shades are used but are specified "oil soluble." The same applies to spirit stains with the exception that the name of the color must be used with the words "spirit soluble." It would be impossible to give the trade names of these various colors, as each firm or manufacturer has his own trade names.

ADDING COLOR TO PREPARED STAIN.

The foreman finisher must remember that in adding a color to a prepared stain, as a rule it is necessary to increase the liquid or vehicle as well. There are two points to be remembered. One is, changing the shade without changing the strength or depth of color, and the other is increasing the strength. In the former the additional color should first be dissolved and then be added to the already prepared stain which is to be altered. In the latter the strengthening is produced by the addition of color without any more vehicle. It is impossible to give any specific formula or directions that would be applicable to each case.

In changing the shade of a finish, to begin with, the finish must be removed. If it is a wax finish, most of the wax can be taken off with turpentine, naphtha, or benzole. This is cheaper than the prepared varnish removers. The removal of the wax coat will bring you down to the shellac; this can be removed with alcohol. In case the wood has been filled, and the piece is to be finished in a style which carries with it no filler, the pores must be opened and the filler removed with a picking brush. It will be found expedient to give a good sponging with a strong alkaline solution which should be washed off with a clear coat of water, when as a rule the filler will lift. The work is then thoroughly sanded, and should be by this time back to the white state. Care must be taken in doing this work when applying this method to veneers. One cannot be too painstaking and especially careful with the alkaline and water for fear of lifting the veneer. In case you suspect the veneer to be very thin, do more work with

DANGER OF "LIFTING" THE VENEER.

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the varnish remover, and alcohol, and less with the alkaline solution. Then in sanding, care must be taken not to cut through. Avoid scraping for fear of producing an uneven surface which would later necessitate a good deal of sanding. When the wood has been brought back to the white state, follow the directions for finishing according to the directions in any one of the finishes that may be selected. The matter is simplified where the change of shade is for the darker, as from a light golden oak, a cathedral to a fumed or an Early English. Avoid attempting to produce finishes that are not in conformity with the regular styles, such as attempting to make a mahogany on oak. Always see to it that the change is compatible with convention.

AVOID ANY CUTTING THROUGH OF VENEER.

In changing golden oak to a fumed, little difficulty is encountered, as the finish as a rule does not penetrate and the removal of the filler is not so exacting. But avoid a job of changing a genuine fumed to a light golden oak, or in fact any kind of a color that is lighter than the original fumed oak. It is well to ascertain whether the fumed is a genuine fumed piece or whether it is stained fumed oak.

In mahoganies, some results may be obtained by applying bleaching methods where the shade is to be made lighter. But, here again, you are apt to encounter difficulty when the veneer portion of the furniture is to be treated.

TWO LIGHT STAINS ARE BETTER THAN ONE HEAVY.

It is well to remember that in changing finishes, and especially where the change is to match some other piece, it is safer to apply a weaker stain, and repeat the operation, than to apply a strong stain which may prove too dark. It would be better to make tests on pieces of wood before attempting it on the original work. Always remember, that if the finish after the filler and the first coat of shellac has been applied, should be too light, considerable doctoring can be done by incorporating a bit of color in the second coat of shellac.

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CHAPTER XLII.

COAL TAR PRODUCTS IN FINISHING ROOM.

FROM coal tar many products are extracted or produced, either directly or indirectly, which prove to be of considerable interest to staining artisans. We are indebted to the so-called light oil fraction of the tar for the large majority of these products; some few, however, are obtained from the other fractions.

LIGHT OIL FRACTION PRODUCES COAL TAR PRODUCTS.

The writer will confine his efforts to giving you in detail only the characteristics, uses, etc., of those products of special interest to the finisher, all of which incidentally are taken from the light oil fraction.

We will mention, however, in passing:

CRUDE AND REFINED CRESYLIC AND CARBOLIC ACIDS, extracted from the carbolic acid or middle oil fraction, which are occasionally used on account of their exceptional solvent and penetrating actions. These actions are stronger and more pronounced than the corresponding actions of some of the lighter distillates of a neutral nature. They cannot be used in all cases, inasmuch as they often "burn" or otherwise affect some delicate shades.

NAPHTHALENE AND PHENOL (REFINED CRYSTAL CARBOLIC ACID), obtained from the same fraction, offer themselves as bases for some coal tar colors.

ANTHRACENE, from the anthracene fraction, is likewise used in the same manner.

SOME OF THE COAL TAR PRODUCTS.

HEAVY TAR OILS AND PITCHES, the former a widely fractioned crude, is often used as a paint without alteration; while the latter, which are residues, are used as bases for crude paints or various natures.

After the crude coal tar has been fractioned into light oil, middle oil, heavy oil, and pitch, the light oil fraction is further distilled by the general methods of fractioning with a column still heated by steam. The temperature gradually rises until a fraction of liquid comes off in a steady stream at approximately 82° centigrade. This is crude benzol and is run into a

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tank for further refining. The still temperature rises steadily and at about 110° C. a crude is collected that is called toluol or methyl-benzol. Crudes continue to come off from there to about 145°. These are stored to refine xylol or dimethyl-benzol, then to 160° these give us solvent naphtha, and so on up to 200°, where heavy naphtha comes off. After these products, follow the creosotes which cannot be graded as to boiling point, nor be classed as benzols or naphthas.

HOW VARIOUS PRODUCTS ARE OBTAINED.

Now we shall go back to our crude benzol. This as you see is crude and possesses considerable odor. This is washed with acids and alkalies until all the impurities are out and then it is redistilled in a more highly developed type of still and we get the water-white benzol as a result. This is drummed off as it comes out of the condenser and an individual analysis shows whether it is benzol pure, 100%, 90%, or 50%. This is done by distilling it in a small flask and condenser, and the per cent that has already distilled over at 100° C. is taken as the basis of grade. For instance, a drum having 100% volatile at 100° is called 100% benzol; 90% benzol having evolved at 100° is known as 90%, and so on down. A drum, of which the sample will show the entire amount volatile within two degrees of 80°, is listed as pure.

The crude toluol is refined in the same manner, but is divided only into pure (that which all distills in 2° of its true boiling point 110°), and commercial (90% of which is volatilized at 120° C.).

Pure xylol is refined to a fraction, all of which boils between 135° C. and 140° C. When a fraction is obtained which tests 90% distilling at 160°, this form is termed solvent naphtha.

Heavy naphtha is not further refined, and with that is offered unrefined benzol and toluol, which are offered to the consumer as straw color. Bear in mind that they are the same as the water whites, but are not given a treatment to remove the impurities which impart a color and odor. There is also a straw color, or unwashed solvent naphtha, that is offered under various trade names, usually determined by the company offering them, "Barrettol," etc.

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This completes the list of benzols that are refined in this country, and as to which is the most suitable to the artisan, it is so largely a matter of personal opinion, that it will probably be best to sum up all the possibilities in each.

All of these benzols can be used interchangeably, that is to say, that one will do the work of the other, because they all have approximately the same diluting, thinning or solvent power. They are in respect to each other the same hydrocarbons, but having different boiling points, they have correspondingly different rates of evaporation. With this point in mind, let us consider each separate grade.

BENZOLS REFINED IN THIS COUNTRY.

PURE BENZOL—Low boiling point and very quick in evaporating. Should be used as a solvent only where a strong solvent and quick evaporation is desired. This material is particularly designed for the rubber trade and for manufacturing other chemicals, such as aniline, myrrhbane, synthetic phenol, etc.

100% BENZOL—Used generally as a solvent where people want to volatilize at the temperature of steam, i. e., 100° C.

90% BENZOL—This is the best known grade, has a fairly fast evaporation, and for solvent power and thinning properties may be used as the typical benzol.

50% BENZOL—Is the same as the preceding, but merely a little slower in evaporation time.

TOLUOL PURE—Designed chiefly for manufacturing purposes, such as benzoic acid, etc.

TOLUOL COMMERCIAL—Water-white as all before, but the boiling point has increased so as to about treble the evaporating time of this grade as compared with the first distillates. In fact, this is slow enough to have some brushing quality, and is for that reason preferred for certain classes of work. The solvent power is relatively the same.

PURE XYLOL—Designed for drug and scientific purposes.

SOLVENT NAPHTHA—A water-white product, quite slow in evaporation; in fact, more nearly approaching turpentine with a corresponding increase in brushing quality than all others gone before, and here the boiling

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point has increased sufficiently to raise the flash point to a point of safety. The flash points of the others are very low.

STRAW COLORS—The properties of each of these may be described by referring them to each corresponding water-white: Straw color benzol corresponds to 90% benzol; straw color toluol corresponds to commercial toluol; crude solvent (Barrettol) corresponds to solvent naphtha. It should be remembered that they will do the same work, but that their color and odor make them less desirable at times.

PROPERTIES OF VARIOUS BENZOLS.

HEAVY NAPHTHA—The heaviest one of the coal tar naphthas possesses a high flash and a dark color. It has still the same strong solvent power as the preceding ones, and the same characteristic odor.

From this discussion it will be seen that several of the products bear very general likeness to each other and that their behavior toward other materials is generally the same, consequently the most conspicuous variation is the one we are inclined to group them by, and that property is the one that the artisan must look to also as his method of determining which he is to use. I refer to boiling point or evaporating time. We can eliminate certain grades immediately, and by choosing the following grades we will include one of each type that will determine the benzols suitable to the artisan;

BENZOLS BEST SUITED TO ARTISAN.

FAST BENZOLS.....	90% benzol. Straw color benzol.
MEDIUM BENZOLS.....	Commercial toluol. Straw color toluol.
SLOW BENZOLS.....	Solvent naphtha. Heavy naphtha. Crude solvent (Barrettol).

It will be seen that by ignoring the pure grades, it is possible to eliminate the higher priced articles. While these are quite worth the difference in cost, as a rule the ones mentioned are sufficiently worthy for

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the purposes they are used for to be called suitable.

As to the uses the material may be put to, it is hard to define any limits, because some one individual may prefer it for purposes where other solvents would do just as well. Some times where it would be by far the best, the other solvents still have the precedence; but as a general thing, the uses may be grouped under the specialties which are best enumerated as follows:

VARIOUS USES OF BENZOLS.

Paint and varnish removers consist largely of benzol, and the consumption of such compounds is very large in this country and the demand is divided between alcohol and benzol. We refer now to the neutral and patented removers which are on the market. A great many individuals and manufacturers use the acid or carbolic varieties, thus avoiding certain of the patents, but at the same time a great deal of benzol goes for this sort of a use. Also a fast benzol is used by a great many, and recommended by not a few chemists and manufacturers for cleaning up the surface after the remover has been allowed to do its work and been wiped off. This is particularly advantageous when a remover carrying a paraffine blanket has been used, as the benzol penetrates the pores of the wood and tends to remove the wax that has remained in the fiber, which is desirable when the surface is to be revarnished.

BENZOL AS A DILUENT.

Benzol as a thinning agent in bronzing liquids has considerable vogue. The varnish varieties of bronze and aluminum paints are frequently thinned with the benzol, because it is possible to get some brushing quality and at the same time use a liquid which contains absolutely no free impurities which would tend to discolor the powder. Also the gravities, being considerably heavier than the petroleum naphthas, support the heavy pigments so much better that the liability of caking is decreased. The cotton or banana liquid vehicles carry very often considerable benzol, because of its cheapness and the fact that the coal tar naphtha imparts a certain silkiness to a cotton film. When gun-cotton or scrap celluloid is dissolved in amyl-acetate, alcohol, or similar material, it can be diluted with the benzol to a point where the cotton does not

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coagulate, thus being considerably cheaper and at the same time reducing the liability of carrying moisture into the mixture as is possible with some other diluents, which have an affinity for water.

OIL SOLUBLE STAIN OUTLET FOR BENZOL.

The oil soluble stain is a very considerable outlet for benzol, and really, when thought over, is a very natural one, since the oil soluble stains are made from aniline, which is in turn made from benzol; and it is generally agreed that it is quite natural to dissolve one substance in a material of a similar nature. In this way the permeability of the anilines is increased and the solution can be made much more readily. A large point in the favor of coal tar naphtha is of course its penetration. In fact, it is quite remarkable that a spirit stain, having been treated to make it soluble in oil, may be put into benzol quite to the limit of solvent power, and yet the stain when applied will penetrate a very closely grained wood to a considerable depth; in fact, to a much greater depth than if the material were dissolved in alcohol originally.

Some claim that anilines thinned with benzol take on a certain tone or softness, but since there is no chemical reason for this, it is believed it is largely a matter of personal opinion. Since we know that many people using benzol become quite attached to it and form very decided prejudices in its favor, we can readily understand this attitude. Of course, there is also the oil stain in which pigment colors are used, where benzol on account of its gravity, penetration, and brushing qualities is to be desired, as well as in the real dyes.

HOW BENZOL FIGURES IN VARNISH.

Varnishes and the demand that they make upon the benzol market in a way is hard to describe, since a great deal of benzol may go into varnishes in the form of turpentine substitutes. That is, people who make turpentine substitutes for their own use may take a percentage of turpentine for odor and brushing quality, and a per cent of benzol for solvent power, penetration, and the like, and the rest of benzine for cheapness. A great deal of varnish is probably thinned with a material like this, but it does not warrant calling benzol a thinner for varnishes in the sense that you

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would turpentine or benzine. We refer to the oleo-resinous varnishes.

Spirit varnishes of course carry a great deal of benzol, because the solvent power of benzol for damar and rosin is very marked. Manila is cut very readily by the use of alcohol and benzol, as are a good many of the hard copals. This feature of benzol is a remarkable one and as yet not very clearly explained. In fact, a separate group of solvents might be called the conjunctive solvents; benzol with alcohol, with acetone, with amyl-acetate, and various other solvents would seem to form a mixture with a solvent power greater than the individual powers of any of its constituent parts.

FURTHER USES OF BENZOL.

In the enamels and japans the use of a small amount of one of the refined benzols is recommended by some authorities; "the complete evaporation" quality of the thinner in question being the point that prompts such a recommendation. Considering in such a case that when the enamel or japan has been properly thinned and applied in a satisfactory manner the benzol has completed its work; the fact that upon drying (fast or slow), this thinner leaves behind no oily or gummy residue to mar the resultant finish, should appeal as an advantage. This outlet for coal tar thinners has never proven to be a large one. The characteristic odor of the distillates, which to some people appears unpleasant, has been one drawback. This applies especially in cases where oven drying, or hot room drying, is resorted to.

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CHAPTER XLIII.

ENAMELING FURNITURE.

ENAMELING furniture, whether upon new or old work, must have the surface in proper condition, well filled, smooth, and shellaced; then sanded and dusted.

ENAMEL WORK NEEDS PROPER SURFACE.

The finest finish may be obtained in the following manner: When surface is in proper condition, apply two coats of enamel priming white, the second coat being slightly tinted with the finishing color, if the finishing coats are not white. Allow 24 hours for each coat to dry and then sand lightly with 00 sandpaper. Next apply a coat of enamel of the color desired for the finished work. Flow on thin with a chiseled varnish brush. Avoid "lapping" by not brushing over the enamel after it has begun to set. Should enamel not work freely, add a very little turpentine. Allow 36 hours for enamel to harden and then rub with curled hair or with pumice stone and water. Apply the next and final coat in the same manner. If a regular enamel gloss finish is desired, this is all that is necessary.

A rubbed finish may be imparted by rubbing smooth with powdered pumice stone and rubbing oil, or water. Use a piece of rubbing felt kept well saturated with the oil or water and dip in pumice stone, rubbing surface smooth and removing brush marks. Allow enamel to stand three to four days before rubbing.

"LAPPING" TO BE AVOIDED.

A polished finish may be obtained by polishing with powdered rotten stone and polishing oil, or water. Use soft cloth or cotton waste, kept well saturated with the oil or water and dip in rotten stone, rubbing surface until a high lustre appears. Allow the rubbed finish to stand at least 24 hours before polishing.

An average finish may be obtained by applying two coats of primer and one coat of enamel, as described, the last coat being left in the enamel gloss.

An inexpensive finish may be had by applying one

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INEXPENSIVE FINISH.

coat of enamel by flowing on evenly with a chiseled varnish brush. Avoid lapping by not brushing over enamel after it has begun to set. Should the enamel not work freely, add a very little pure turpentine, but not enough to dim the lustre. This finish will not do if the enamel is lighter in color than the old finish; in that event, follow directions for an average finish.

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CHAPTER XLIV.

SPIRIT STAINS IN FINISHING.

THE very title of these stains describes them. Generally they are a solution of spirit soluble anilines which are classified as basic colors and which are generally not fast to light. The durability of their color necessitates stains of this nature to be well protected with coats of shellac, keeping out all of the air. When subjected to sunlight, they will fade, no matter how much finishing has been done over them. There are places where their use is permitted, and there are occasions where the employment of spirit solutions is the only method thus far obtained for producing the required effects and results.

PROCESS TO BE FOLLOWED.

Spirit stains are made by dissolving such colors or combinations as will produce the desired shade. Little filling is done where they are employed. Wood alcohol is the more common solvent, with denatured alcohol and grain alcohol sometimes used. Heat is never employed. Loading of the liquid will cause bronzing, which is the congealing and drying of the aniline on the surface, because it cannot follow the alcohol vehicle in its penetration, and because the evaporation exceeds the speed of penetration thus leaving it in a thin film on the surface to which it has been applied. Covering spirit stains with shellacs must be done quickly and without restroking the surface. The same applies to the application of the stain itself.

Spirit stains have one advantage, which is that they do not raise the grain, but produce quick and desirable results where they are not exposed to air and light, such as the interior of drawers and case work.

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CHAPTER XLV.

THE CARE OF STAIN MATERIAL.

A GOOD rule, for any finishing department, is to insist on finishing material being kept in sealed packages. Liquids must always be well corked; kept in a moderately cool place. Liquid solvents will evaporate and the lighter portions which evaporate are many times the stronger factor in solvent qualities and thus the remaining liquids are not as efficient as the original.

KEEP LIQUID STAIN IN COOL PLACE.

In mixed dry stains, where it is possible for the mixture to be made up of coarser and finer powders, there is danger from the coarser powders finding their way to the top of the package through the continual vibration of the factory. In that case the removal of the upper portions would not be an exact representation of the general contents of the package. Such stain material should be shaken thoroughly and care should be taken that the mixture is complete before employing any part thereof.

In chemicals, especially those in crystalline form, some may be hydroscopic, others may be deliquescent, by which is meant, that one absorbs moisture from the air, and the other gives off moisture, so that where small quantities are employed the actual amount of the chemical might vary considerably had they not been properly cared for. Uniformity of product is an essential. Upon the stain product depends the entire success of the finish. It should always be remembered that it is wise to keep in an air-tight package a sample of the original stain, especially with the anilines, so that as each new batch is obtained it may be compared with the original. A simple matter for example:

KEEP SAMPLE OF ORIGINAL STAIN.

Weigh out five grains, dissolve it in a pint of water. Then weigh out five grains of the original, dissolve it likewise. Pour the contents in separate cylinder glasses of like diameter, compare the color. For a check on this comparison, take pieces of white blotting

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paper and immerse them in the solution. They must compare both when wet and when dry.

MANY STAINS VARY IN COLOR VALUE.

Where vegetable extracts and dyestuffs are employed, it is more essential to keep a sample of the original solution. These products often vary in their color value, and unless they are matched with the original by either employing more or less in the making of the second solution, and thus preparing an exact duplicate, the stain so produced is apt to fall off in shade.

CAUTION.

WHEN USING IRON IN ITS VARIOUS FORMS IN THE PRODUCTION OF STAIN.

The most common form of iron found in the market is sulphate of iron, commonly known as copperas. (So named because it has a greenish color.) This, however, is one of the most unstaple forms to use. When employed, the following precaution should be taken. When employing sulphate of iron in the crystalline form, see to it that only the fresh crystals are used. This will be of a glossy appearance. When exposed to the air, the water of crystallization evaporates, leaving a white powder on the exterior of crystal. This represents much more iron than the same weight of crystal and thus the shade of the stain will be greatly changed. It will be darker, which may not be noticed at first, but if it is allowed to continue by the use of the same stain made up repeatedly, the drying out process at the same time increases the amount of iron in each batch, finally these will be so much different in the color produced, that one would not imagine them to be of one and the same formula.

USE OF SULPHATE OF IRON IMPORTANT.

It is to be recommended in establishing new formulas, to use the dried sulphate of iron. This is a staple compound and none of the foregoing difficulties will be encountered.

In stains that are made up for immediate use, the standardized solutions of iron are recommended. Solution chloride of iron U. S. P. or solution sulphate of iron U. S. P. are undoubtedly the most readily obtained. A very small quantity will produce immediate effect on practically all woods, especially those rich in tannin.

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CHAPTER XLVI.

FINISHING GUM AND ITS USES.

THE uses that gum wood are put to today are quite diversified. It is put out as Circassian, and as mahogany, but now there is a strong disposition to give it a shade and put it out under a style of its own. At the same time it makes up beautifully when stained to produce the same as that of the adopted color for American walnut. The stain material employed is nothing more than walnut crystals, and imported dye, universally known to the trade, and a very weak solution at that. The dye is prepared by dissolving any given quantity in boiling hot water, allowing it to cool and then passing it through a filter. This concentrated solution is then diluted until it produces the desired shade. One coat of stain is all that is applied. From this step on the procedure is the same as in any finishing problem.

WALNUT CRYSTALS EMPLOYED.

Whether it is gum wood or Circassian that is to be finished as Circassian walnut, the question of the last coat always spells lacquer. Circassian, as we know, is finished in natural. Gum is only stained to bring it to its natural Circassian color. Some call it overcoming the red in the gum. The final achievement must be an exact reproduction of the genuine article. What can be produced by the use of wax is known to every manufacturer. The use of lacquer remains an unsettled opinion. Its use is not new, having first been employed on a finish put out on gum as satin walnut and in connection with verda green.

GUM WOOD PRODUCES BETTER THAN NATURAL FINISH.

Gum wood, with a very small amount of stain, will make a much more pleasing appearance than if finished natural. Without the stain, it takes on various tones of cold gray which is difficult to describe, but which it is certain does not have the pleasing effect which comes with warm tones which are more desirable and will wear better. Therefore, the application of this brown overcomes this possible difficulty, and as the wood ages it tends to mellow down the cold effect that the gum

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wood is prone to assume. This does not necessarily cover the process of staining gum wood when it is used as a substitute for American walnut. In other words, the gum wood used in this sphere is stained to match the prevailing style of American walnut, and finished in the same manner. The main point is transparency, such as one wants on Circassian finishes. By Circassian finishes, is meant, of course, all the kindred kinds.

ONE COAT STAIN FOR VAN DYKE.

When finished as Van Dyke, and the formula pubpared and ready for the staining, a one coat stain is preferable. Whether it be a water stain, spirit stain, or oil stain, it is not to be filled. White shellac is used rather thin, sanded lightly, and the varnish coats. Any style of final finish may be employed.

When finished as Van Dyke, and the formula published employed, the directions there given will bring the proper results. This is true when finished as moss brown, verda green or any of the other finishes that may be applied to gum.

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CHAPTER XLVII.

SYSTEM IN MATCHING STAIN COLORS.

WE WILL admit that a very important part of the finisher's daily routine is the matching of colors sent to him representing the style and shade of finish for a special order. Undoubtedly, the house that is selling the goods has a portion of the order placed with some other factory—yes, possibly two or three. It is up to each finisher making a portion of the order to make as close a match and duplication of the sample sent him as possible. A great amount of time is thus taken in experimental work. The big mistake, however, is that these matchings are hurriedly made and the different treatments are not permitted to ripen. Thus the sample is not correctly matched because after it has stood for a week the color may change considerably. Therefore, if the operation is hurriedly done, although the match at the time may be perfect, the regular work that comes through may be several shades off.

IMPORTANCE OF MATCHING COLOR.

In my experiments I have found that time is gained by giving the stain coat the same amount of time as it would receive in the regular line of work. The procedure is about as follows:

Having had the advantage of matching hundreds of boards, it follows one gets an idea of how the color was made. Every time a new sample comes in, it is easy to turn back and, by comparison, pick out the sample that comes nearest to matching, and then change the formula enough to produce a similar shade to the new board just received. But in a factory the proposition may be somewhat different. The foreman may have been working on a limited line of colors. Again he will not have on hand a large variety of shades to make up his matching. But if he has been following these articles, he undoubtedly is familiar with the few absolutely requisite color products, and the chemicals, and the anilines, and has them on hand. I have stated that time is saved by giving the stain

PROCEDURE IN MATCHING.

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coat the regular amount of time to dry and to set. This applies to either water, spirit or oil stains. But if each matching was to be given this amount of time the customer would be calling for the goods long before the shade was matched by the finisher. Therefore, I recommend that first the finisher make a strong solution which he knows is too dark, and then make 10 more dilutions, until he has one which he knows is right. You will see at once that there will be 10 intermediate points. Now then, when these 10 little boards dry out it is an easy matter to select the one which matches closest.

WORK FROM DARK TO LIGHT.

Where a two-stain proposition is to be handled, the same method is recommended, for the second coat is prepared in the same way and applied in the same routine and permitted to dry. But it will be seen that the 10 original pieces can be made into a hundred matchings, as each one of the 10 can be coated with the 10 of the second stain. When you first look at a proposition of this kind it may stagger you, and you will say to yourself, "Why, this man wants me to make 100 test samples." Not so at all. You lay the first 10 little pieces, say a board four inches wide and 12 inches long. Lay the 10 of them alongside, then take your 10 dilutions of the second coat and brush over the entire 10. With a lead pencil mark each board "top." Then, from the top down, you cross the ten boards 10 times with each one representing first solution, then with the first dilution, and so on until you have 10 boards, the first coat of which has been crossed 10 times, with the result that you have 100 squares made out of two stains, showing 100 different shades. The chances are very good that you will have some difficulty in selecting from a few the one that suits you best.

TESTING SAMPLES.

But don't stop here. Finish up the entire 10 in the same manner as the board sent in was finished. You know how to test this sample as to its finish, whether it is wax, varnish or just shellac. Find this out and then proceed to finish the board in the same manner. It might be well for me to say, however, that if the wood was filled, you have got to put on the filler and establish in your own mind the depth of color of this

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material. Fillers don't vary so very much and if they do, make up your mind that there are only three or four pigments usually employed in their makeup.

Of course, the kind of wood employed makes a good deal of difference. You are supposed to have selected for your samples the same kind of wood, as near the grain as possible, and, of course, you found out whether it was red or white oak. In short, you have gone through all these preliminaries and have filled the wood and are now prepared to put on the final finish. Go right along, put on the shellac, give it the regular time, then varnish, let it dry and finish to match the sample. Now it is up to the final matching. Carefully examine the little places. You have numbered the boards, you have them all marked "top." Put them in the same position and select the one which matches to your own satisfaction. Then you back up and for argument's sake, find that it is number six on the fifth board. The first board represented your first solution. You may have added 5 or 10 per cent of water for each dilution. Then multiply the strength of your stain by the number of the board, and it must prove up to strength of the original board. If you know the amount of stain powder used in the first solution, you will see how readily you can figure out the strength of your fifth board. This covers the first coat.

KIND OF WORK MAKES GREAT DIFFERENCE.

But you have the sixth in the second coat which works out the same way. Now suppose you don't do it on the percentage basis at all and we will say you took a quart of water and added to it an ounce of stain powder. You found this was much too light. I would here suggest, then, that you take a half pint of water and to it add first a quarter ounce of powder, which is the same strength as an ounce would be to a quart. Then gradually add 30 grains of powder until you have a shade that you know is darker than it really ought to be. I say 30 grains because 30 grains is half of a dram, and it keeps your figures more in direct relation to the weights you are employing. Consequently, when you come to figure it will enable you to avoid the many little pitfalls which are due to errors in calculation, especially when you are increasing your

WORKING ON PERCENTAGE BASIS.

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formula in weights and measures. Then again you must remember that the amount of water is going to increase with each dilution. You take eight ounces of water to begin with and suppose that each dilution is made by the use of one more additional ounce of water. When you get through you will have 17 ounces of water in the 10 dilutions. The 17 ounces of water will represent the same amount of powder that was contained in the original eight. As a rule, I have found that you usually find by this method the fourth, fifth and sixth dilutions as bringing out the shades. Of course, you thoroughly understand that your judgment of the colors selected has been correct, but if it was the fifth dilution and you have used the quarter of an ounce, then you have a quarter of an ounce of stain powder in 13 ounces of water, from which it is easily calculated how many grains would be to the gallon, for you would divide the number of grains by 13 which gives you the number of grains in each ounce. Then you would multiply by the number of ounces contained in a gallon and thus arrive at the amount of stain powder to be employed to each gallon of water.

PROCEDURE CONTINUED.

But suppose that the powder or color material does not give you the desired shade, and it thus becomes necessary to try out several colors in order to produce the shade. Proceed in the same manner and if you wish to assure yourself that you have selected colors that will make the shade, take a graduate, add a little of the one in which you have the most confidence, and then shade it up by the addition of the other two or three as the case may be, until this preliminary test convinces you that you have the correct components. Then start out to ascertain the correct strength. Do it in the same manner. Take the 10 boards, coat each one with the first solution, cross it with the second solution. Go back to the first way with the third solution and so on until all the solutions have been applied. Somewhere in the square you will have your match. Then you figure back for the amount of powder that you require. Now, if you wish to prove this, weigh out the amount of powder shown you by the key, and dissolve it in the amount of water, but be sure not to fall

ASCERTAINING CORRECT LENGTH.

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into this pitfall. The most natural thing to do is to find out the amount of powder and forget to multiply the amount of water employed. In other words, each color had been dissolved in the same amount of water. Therefore, it becomes necessary to multiply the amount of water by the number of colors you have employed and a slight error becomes greater when it becomes absolutely essential to see to it that a complete solution of the color material has been made. If you wish to be absolutely certain, put a bit of cotton in a small funnel and run the solution through this. If no sediment is left on the cotton, you can safely go ahead, but if there is sediment, throw the cotton and the sediment into the graduate and vessel and agitate the mixture until the solution is complete. Always bear in mind that you are operating in diminutive quantities and that a slight error becomes greater when it comes to make up the formula into gallon lots.

TESTING THE SOLUTION.

In a chemical formula, and the one now uppermost in the trade is fumed oak, I strongly recommend doing the varying in the bichromate of potash rather than in the alkali, such as caustic, carbonate of potash or ammonia, as the effect of the alkali is practically governed by the one ounce to the gallon formula, and the variance of the shade is more readily produced by the strength of the bichromate.

Where a first coat of tannic or pyrogallic acid is given, increase the strength in the pyrogallic acid rather than in the strength of the tannic acid, and bear in mind that the atmosphere has a whole lot to do in turning these chemicals brown. That pyrogallic acid mixed with an alkali turns brown, and that some of the most beautiful shades of brown can be produced by mixing a solution of pyrogallic acid with carbonate of soda or potash, and sulphite of soda, coating the wood with this and entirely omitting the bichromate, is true. To those who are not using a fuming box, let me suggest that they make a few experiments. In the few preceding sentences, we have told the trade something. We have told more than is realized, we believe, and if the manufacturer be alert he can work upon the foregoing suggestions to his own surprise and satisfaction.

EFFECT OF ATMOSPHERE ON CHEMICALS.

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AGE OF FINISH OF GOLDEN OAK AFFECTS MATCHING.

In golden oak, where a board is sent in to be matched, endeavor to make up your mind whether it has been of recent finish or whether it is an old sample. Make up your mind whether it is one in which the effect has been produced by the use of a colored filler, by which I mean a filler stain in which some of the stain material has been incorporated. This you can usually tell by closely examining the flake and the smooth portions of the wood. Don't look at the pores at all. If the smooth portions present an uniformity of color, you may conclude that the piece was originally stained and then filled. And again you know that practically all the golden oak is made by the use of an oil stain. Asphaltum being the base, the color is augmented by the use of an oil soluble yellow, brown and black. A good quality of asphaltum is required, and in a case of this kind, proceed about as follows:

Dilute the asphaltum with an equal part of turpentine. Make the solution of the three colors, that is three separate solutions, all of a known strength. Then add to each enough of the asphaltum solution until you have the shade, judging the shade by the flakes only, applying the stain and wiping off with a rag which has been wet with naphtha. Add just enough naphtha to take off the stain clean, for you will find that this stain will look like a brown varnish. You will also notice that by the addition of colors to the asphaltum solution you have diluted this solution, all of which must be taken into your calculations when making up the larger formula. When this formula is produced and you are ready to go ahead, make up the stain and instead of wiping off with a rag, fill it with an uncolored filler. The spreading of the filler will take up the excess stain, and color the filler as it is rubbed into the pores. Then, of course, when this is done, clean up. Care must be taken in matching to go very easy on the yellow, depending largely upon the asphaltum to produce this yellow shade.

While golden oak is supposed to be a more uniform color, you will find by observing factory samples much variance in shade is seen, and the nicety of match can be made by following the above suggestions.

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CHAPTER XLVIII.

SURFACING AND VARNISHING.

IN ORDER to insure a durable finish goods should never be surfaced until the filler is thoroughly dry. This usually takes from 24 to 48 hours. Even if one is in a hurry for the goods, it will be better to make sure that the filler is dry because if it is not and the surfacing and varnishing proceeded with, much more time will be lost through the imperfect oxidation of the oil in the filler and the effect this will have upon the subsequent coats than has been gained. Filler that has been subjected to a temperature of 70 degrees F. for 24 hours may appear to be dry, and if the goods are a cheap grade and will receive only one coat of varnish it might be safe to go ahead and coat them up. In fact, some factories making a cheap line of goods coat all of their stuff within 24 hours after it is filled. But a large percentage of these same shops have considerable trouble with "printing." These factories find it almost impossible to pack their goods for shipment so that the impress of the wrapping paper is not left upon the varnish. Some shops making a medium and high grade line are trying to crowd their goods ahead quickly during the early stages of the finishing process, and no matter what time they give their varnish to dry they have trouble with printing.

SURFACE WHEN GOODS ARE DRY.

IMPORTANCE OF EARLY WORK BEING DONE WELL.

If there is one time more than another when patience should be considered a virtue in the finishing room that time is during the early stages of the finishing process. It is now the foundation of the future beauty of the goods is being laid and much depends on how the work is done. These remarks apply of course to factories that keep their finishing rooms at a temperature of about 70 degrees F. Where the highest quality of a durable finish is desired the installation of a high temperature drying system may well be considered. Goods finished a quarter of a century ago in a temperature of 70 degrees still look well. Will the

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same thing be said 25 years hence of goods finished today in a temperature of 130 degrees? If we will not be able to do so it will not be because the system is wrong but because we have applied the system to the wrong material.

AVOID GREAT TEMPERATURE CHANGES IN VARNISH.

Varnish makers of the past decade have been endeavoring to produce a varnish that will give good results in a temperature of 70 degrees, and suddenly and without any change in its composition to submit it to a temperature of 130 degrees is certainly a problematical experiment. Unless varnish, after it is thoroughly dry, retains a certain amount of its original elasticity it cannot withstand the varying temperatures to which it will be subjected. We know that varnish that is subjected to a very low temperature within a few hours after being applied loses its elasticity much sooner than would otherwise be the case, and very often cracks before it leaves the factory. Whether extreme heat will produce a similar result has yet to be determined and the question cannot be settled for some time to come.

However, in the natural order of things, the more rapid systems for the finishing room that are knocking at our doors must be admitted sooner or later, and they are bound to stay with us. When varnish makers take the new order of things into consideration and adapt their wares to it, the system of rapid processes in the finishing room will be recognized as the standard of up-to-dateness and finishers will listen to the veteran's tales of today and wonder at the snail-like pace of that bygone age. That time is coming.

WHAT IS THE BEST SURFACER?

What constitutes the best surfacer is a question that has received serious consideration in many quarters for several years. For many years shellac was the standard surfacer for all kinds of work, but when the price rose from 15 to 65 cents per pound, a demand was created for a more moderate priced article and the varnish surfaces came into being. But varnish surfacers have not always given entire satisfaction. This was not because in the nature of the case a varnish surfacer was not a good thing, but because many surfacers were made of cheap materials and were used on work

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for which they were entirely unsuited. The majority of varnish surfacers contain a pigment and for that reason must be used with extreme caution on woods that are easily clouded. On oak a varnish pigment surfacer is preferable to shellac. This applies only to such oak finishes as are bodied up with varnish and are stained with a stain which turpentine will not lift. Turpentine stains must be held down with a coat of thin shellac before they can be filled with oil filler, and the stain that will lift with an oil filler will lift with a varnish surfacer. A varnish surfacer may be used, however, as a first coater over such stains after the wood has been filled.

MOST VARNISH SURFACERS CONTAIN PIGMENT.

Every finisher can make his own surfacer, which is a comparatively simple matter, and by making it himself he can have a high grade article at the price of an inferior one.

In making surfacer it is well to use the same grade of varnish that will be used for bodying up. It has been difficult to understand the process of reasoning by which men come to the conclusion that there is some advantage in laying a foundation of cheap material. The axiom that "the chain is no stronger than its weakest link" is as true here as elsewhere. A heavily coated piano may have the under coats of varnish badly cracked while the outer coats are yet good. But so far as the appearance is concerned, the outer coats may be of the same material as the under ones, because the cracks show through, and soon the outer coats are cracked also.

USE SAME GRADE FOR SURFACER AS FOR BODY.

One of the disadvantages of a varnish surfacer is that it ought not to be coated over the same day that it is applied, whereas shellac may be coated over inside of a few hours. If one will put his stuff through the finishing room in a systematic way, this seeming disadvantage will not be noticed. Allow a given time between every operation, then every job will be ready for the next process when it is required, and it will be required when it is ready.

The following formula has been tested for several years and when made of good materials it has no superior:

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1 gallon Varnish.
½ gallon Brown Japan.
1 quart Pure Turpentine.
6 lbs. very fine Silex.

TESTED FORMULA FOR SURFACER.

Mix the first three liquids and allow them to stand for half an hour or so and then put in the silex. It is well to sift the silex to remove any foreign substance and reduce any lumps. Allow the mixture to stand 24 hours; strain through book muslin and reduce with benzine as required to the proper consistency. When using keep it well stirred from the bottom.

The proper proportion of silex to japan and varnish depends on the body of these two parts. In the foregoing formula it is one pound of silex to a quart of the liquids. That proportion is correct for a varnish with a good body. The quantity may be increased or decreased as the actual working out may prove to be required. It should dry flat, but not too dead. If too dead, less silex should be used. When the proper proportion of the ingredients has been used, it will sand almost as easy as shellac, and produce a beautiful, smooth surface for the varnish. It does not require to be brushed more than enough to spread it out, and it may be put on as heavy as one may wish without danger of crawling.

One of the chief advantages of a surfacer of this kind is that being of the same material as the varnish, the two will unite much more perfectly than will shellac and varnish, and there is less danger of the latter chipping off.

LESS VARNISH USED THAN WHEN SHELLAC IS USED.

A surfacer of this kind has no equal for medium close-grained woods such as curly birch and bird's-eye maple which are to be finished natural color. In addition to making a perfect surface for the varnish, it fills up all the minute pores of the wood and, consequently, less varnish is required than when shellac is used. For these finishes the surfacer is applied on the bare wood and no filler is required.

To finish maple stained mahogany, this surfacer may be applied to the stained wood without filling, but it would be advisable to add a little extra varnish to prevent clouding. The pores of stained wood, if a

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spirit or water stain has been used, are more open than when the wood is in the white and are liable to draw the varnish away from the pigment and leave it opaque and gray. But if a first class job is desired a better way would be to apply to the stained wood a coat of very thin shellac before the surfacer is applied. This will enable one to make a perfectly smooth foundation for the surfacer. The shellac will seal up the minute cells of the wood, and when sanded will remove any fuzz which the stain may have raised. A foundation for the varnish prepared in this way will require much less varnish and less rubbing to produce a high class finish.

METHOD OF STAINING MAPLE AS MAHOGANY.

What is known as Surfaced Oak or Golden Oak Finish is an imitation oak finish with the figure of quartered oak printed on the wood. Some factories have trouble with the figure chipping off. Where this trouble is experienced, the cause is usually in the fact that the printing was done on a coat of surfacer instead of on the bare wood.

This imitation oak is best made on wood which shows very little of its own figure and has very little color. Birch and maple and sometimes basswood and other light colored woods are used usually. The wood is not stained, because to do so would draw out its figure. The color is built up with the various coats. To prevent these colored coats from drawing out the natural figure of the wood, a coat of pale, colorless surfacer is applied to the bare wood, and the color is built on top of this. Some finishers put this pale surfacer on before the stock is put through the printing machine. That is a mistake. The better way would be to do the printing on the bare wood and put the pale surfacer on top of the printing. In this way the printing will last as long as the wood lasts and there will be no trouble from chipping. When the printing comes in between two coats a good union is not formed; hence the frequent trouble.

IMITATION OAK FINISH.

While this varnish pigment surfacer is adapted for a great many woods and finishes, there is one wood for which we cannot recommend it, and that is mahogany. It may be used even on this wood if it is to be finished

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a very light color, and the surfacer is made with a very small quantity of the pigment. But this is not desirable. The best surfacer for mahogany is bleached shellac. This should not be used very heavy; not more than two pounds of gum to the gallon of solvent. Methylated spirits or denatured alcohol, if pure grain alcohol cannot be obtained, should be used as a solvent.

PIGMENT SURFACER NOT GOOD ON MAHOGANY.

In using bleached shellac the utmost care must be exercised. Bleached shellac is a very perishable article, as a result of the method of producing it. It is ordinary orange shellac from which the yellow matter has been chemically extracted. The chemicals used are chloride of lime, muriatic acid and soda. These are washed out as far as possible after the bleaching process is completed, after which the shellac is dried. But it is not always possible to wash out every particle of these chemicals, and these particles that remain bring about in time a condition known as "calsing," and the shellac becomes insoluble, or only partially so. This condition may be detected by straining through book muslin or cheese cloth. If it is found to contain particles of shellac that have not dissolved within a reasonable time, it is not safe to use it. The use of such shellac will produce a milky cast to the finish which will show distinctly in a clear light.

THE USE OF BLEACHED SHELLAC.

Bleached shellac should not be applied in a cool, damp atmosphere. If the humidity is high it will not work freely and when drying is apt to show white in places, especially where it has lapped when being brushed on. This whiteness will disappear when the shellac becomes dry, but it may not resume its clearness and is likely to give the finish a clouded effect. To prevent this, raise the temperature of the room until the humidity is below the danger point. This can be determined by the way the shellac works. Shellac should be applied quickly and with as little brushing as possible.

A sandpaper with a very fine cutting surface and soft back should be used for sanding shellac. We cannot give the grade because all makes of paper are not graded alike. If the paper clogs it is caused by one of two things. Either the shellac is not dry enough or it

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is adulterated. In sanding large surfaces it is well to use a soft block. Thick felt, such as is used by rubbers, makes a fine sanding block. Large surfaces can be sanded much quicker and more evenly when a block is used for holding the paper than when the paper is held in the hand. If any edges are sanded through, they should be re-stained and shellaced before being varnished. This re-shellacing is necessary because if any of the stain laps over on the shellac it will likely show green after the varnish is applied. The shellac will prevent this.

IN SANDING LARGE SURFACES.

Goods should be thoroughly dusted before they enter the varnish room. Too many finishers are careless in this respect. They see that the parts to be varnished are dusted nicely, but give no care to the rest. This is a mistake. The varnish room should be kept as free from dust as possible and this can be accomplished only by not allowing it to enter.

Varnish should never be put on in a lower temperature than 70 degrees F. and the varnish should also be as near that heat as possible. Varnish will work more freely in a high temperature, and when the wood, the varnish and surrounding atmosphere are about the above named temperature, conditions are ideal.

The first coat of varnish ought not to be quite as heavy as the succeeding coats. If a medium heavy varnish is being used all that is necessary is to put on just a little less. But if the varnish is of heavy or extra heavy body it should be reduced slightly for the first coat. The best varnish reducer is thin varnish. To prepare this reducer, take one part varnish (the same varnish that is to be reduced) and two parts pure turpentine. Shake these together well and let stand 24 hours before using. This will reduce the consistency of the varnish without tearing down the body as pure turpentine would.

THIN VARNISH IS THE BEST REDUCER.

The first coat of varnish should be allowed to dry thoroughly before the second is applied. Here is where a great many finishers make a fatal mistake. They act on the assumption that the first coat of varnish requires less time to dry than the second, and the second coat less than the third, etc. Looking at it from their view-

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point they are right, but their viewpoint is wrong. From their point of observation they see conditions which ought not to exist, and which conditions are of their own making. If the second coat of varnish it put on before the first coat is perfectly dry and hard, we create a condition which renders it necessary to give more time to the second coat than was given to the first, and the same with the third coat. But it is not the last coats that require the extra time, but the coats that are underneath. By putting on varnish in this way we get on three, four or five coats as the case may be, and not one of them dry. Each coat stops drying the very moment the next coat is applied and does not resume until the condition of each is the same. In fact, unless the previous coat has reached a certain stage the last coat will not only arrest the drying process, but will enter into and partially dissolve the under coat, reducing it to a semi-liquid state.

NEED OF DRYING BETWEEN SUCCESSION OF COATS.

The above will explain the reason why so many finishers find it impossible to get their varnish dry after applying three or four coats. If each coat were allowed to dry thoroughly before the application of the succeeding coat, much time would be saved and a better job assured.

Where varnish is to be rubbed to a perfectly smooth finish, the second last coat should not be allowed to become so dry that a complete union cannot be formed between it and the last coat. If this union is not perfect and the rubber goes through one coat into the other, the break between the two varnishes will show up in patches. It is not likely that on four-coated work the rubber will go through the last two coats, at least he ought not to; consequently it will be quite safe to allow the first two coats to become thoroughly hardened before the third is applied. When this is done a much heavier coat may be put on for the third coat than would otherwise be safe, thus minimizing the danger of going through. When this coat is medium dry, the fourth may be put on.

WHY SOME FINISH COATS DO NOT DRY.

A great many varnishers are puzzled at their inability to do clean work, while a fellow workman in the same room, and working under the same conditions,

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has scarcely a speck on his work. Many are of the opinion that there is some great secret about clean varnishing, but there is not. On the contrary, there are many little ones. Much that is called dirt on a varnished surface is not dirt at all, but particles of congealed varnish that have been worked off the varnish pot or out of the brush and spread over the surface. It is a common thing to see the sides and edge and crossbar of the varnish pot heavily coated with congealed varnish, the accumulation of days and weeks and sometimes months. The brush coming in contact with this congealed mass works off fine particles which are gathered up with the varnish and spread over the surface. These particles of congealed varnish harden very slowly and are the cause of much of the trouble the rubber has with "pulling out" when rubbing varnish that otherwise ought to be thoroughly hard.

SECRETS OF VARNISH DRYING.

The remedy for all this is to keep everything clean. The crossbar of the varnish pot should be a moveable one, and should be removed from the pot and cleaned whenever work is suspended for any length of time. If work is suspended for an hour or so, and the varnish is left on the crossbar, it will congeal partially in that time, and when work is resumed the fresh varnish will soften it sufficiently to break its hold and it will be gathered up and carried along in the fine particles. The top and outside of the pot should be cleaned off with a cloth and a little benzine every noon and night. When a brush not in use, do not lay it down in such a way that the hair will come in contact with the edge or sides of the pot. A block of wood, two inches thick and about eight inches square, will be large enough to lay them on with the hair projecting over the edge. The hair of the brush should not be allowed to come in contact with anything except the work it is to do.

KEEPING VARNISH CLEAN.

If a brush is to be out of use, for more than a few minutes, it should be put away in a thin varnish or pure turpentine provided for that purpose. Care should be exercised to see that all brushes thus out of commission have the hair completely immersed in the liquid; otherwise the varnish on the exposed part will harden, and when the brush is brought into use again, this hard

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varnish will crumble and the brush will be known as "lousy."

Attention to these details will bring relief to many a varnisher who is worrying because he cannot do clean work and wondering where the dirt comes from.

HOW TO GET PROPER DRYING OF VARNISH.

The conditions necessary for the proper drying of varnish are a well heated atmosphere with facilities for keeping the air in constant circulation and replenishing the supply of oxygen. The drying of varnish is quite different from the drying of wood. In the latter case drying means the expulsion of moisture which is carried away in the form of vapor by the air. In the former case the varnish extracts from the air as it passes by an element known as oxygen and absorbs it. Varnish throws off very little moisture, consequently the term "drying" is scarcely the correct one. It is a hardening process and is scientifically known as oxidation, the oxidizing of the oils in the varnish by combining them with oxygen which has a hardening effect. Heat is necessary to the proper oxidation because it releases the oxygen from the air, and at the same time renders the varnish more receptive. Circulation of air is necessary in order that the air may be removed from the varnish after the oxygen has been extracted and other air brought in its place. Ventilation is necessary in order that the air that has been depleted of oxygen may escape and fresh air with plenty of this necessary element admitted. This fresh air should be admitted in such a way that it will not become a disturbing factor. It should be admitted in small but steady quantities at various parts of the room, so that it may readily diffuse itself throughout the whole air space without in any perceptible degree affecting the temperature of the room.

RUBBING AND POLISHING.

Rubbing and polishing are important branches of finishing. It is here that the final touches are added and no matter how well all previous work may have been done, it will all count for naught, and may be spoiled entirely, if this work is not done right. Considerable practice is required before one can be an expert rubber. There are various kinds of rubbing. There is the rough rubbing on carriage and automobile

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bodies that is done with lump pumice and water. Some interior finishers, chiefly among house painters and finishers, rub with fine sandpaper and oil.

In piano factories there is the coarse rubbing which is rubbing down to a perfectly smooth surface the first coats of varnish which were put on to make a body and give the finish a depth. This rubbing is done to prepare the body for the final flowing or polishing coat. This is done with coarsely ground pumice and water, the rubbing being done with blocks of thick felt. This rubbing ought not to be done until the varnish is thoroughly hard. But if the goods are wanted rush, a little time may be saved by rubbing down carefully before the varnish is quite hard, and after the rubbing allow the remaining varnish to harden thoroughly before the flow coat is applied. The rubbing will take off at least from one and one-half to two coats which leaves just that much less to harden. In any event a few hours should elapse before the flow coat is applied after the body has been rubbed.

COARSE RUBBING WITH PUMICE STONE.

Then comes the fine rubbing. This is done with fine felt and finely pulverized, sifted and bolted rotten stone and water. This rubbing is done on the flow or polishing coat and the utmost care must be taken not to rub through to the under coats. This coat when properly applied is very clean and smooth and, therefore, requires very little rubbing; the main thing being to rub it evenly all over. After the fine rubbing, 12 to 24 hours should elapse before polishing.

The old method of hand polishing is still in vogue in many piano factories. This is done by slightly moistening the hand with water and with a very small quantity of very fine rotten stone, rubbing the varnish with the hand, using a circular motion. The quantity of rotten stone is gradually diminished until none whatever is on the hand and the final polishing is done with the bare hand, after which the surface is oiled with sweet oil and cleaned off dry.

USE OF ROTTEN STONE.

In furniture factories this method of finishing very rarely is carried out. The goods are varnished with the same grade of varnish throughout and the rubbing and polishing follow each other on the varnish put on

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for a body. If the goods are to be polished they first should be rubbed down smooth with water and medium coarse pumice stone, using felt as a rubbing block. Plenty of water should be kept on the work to prevent the varnish caking on the bottom of the block. No matter how careful one may be in this respect some varnishes will harden on the bottom of the felt, and, if not removed, will scratch and tear the surface. The expert rubber instantly can detect this gathering of varnish on the felt from the feeling of it as his hand draws it over the surface. This caking is more liable to take place where the varnish is not quite hard, but will take place with some varnishes no matter how thoroughly hardened they may be.

METHOD USED IN FURNITURE FACTORIES.

If there are four or five coats of varnish on the goods to be rubbed, it is well to have two grades of pumice, one grade somewhat finer than the other to finish off with. If one attempts to rub down four or five coats of varnish with one application of pumice, he will find before he gets through that there is too much of the varnish mixed with the pumice to enable him to make a good job, and that the caking on the felt is greatly facilitated thereby. If he cleans off this mixture of ground varnish and pumice, and starts to finish off with a second application of pumice of the same grade, he will find the work so badly scratched that great difficulty will be experienced in getting it in shape for polishing. If fresh pumice is required after the rubbing is nearing completion, a fine grade should be used.

FELT USED IN RUBBING WITH PUMICE.

The felt used for rubbing with pumice is a coarser grade than that used for fine rubbing, and may be obtained from one-quarter inch to two inches thick, the latter thickness being preferable for heavy rubbing. It is made in various degrees of firmness, a medium hard felt being the best for this work. Some rubbers, if the work is very heavy, will start to cut down with burlap, using this until the job is about half rubbed, then using the block and finish off with a piece of thin felt. Burlap will hold the pumice better and cut a little quicker than the felt, but the work done is not so fine and the felt must be used afterward.

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If the varnish is fairly hard at the time this first rubbing is done, the fine rubbing may be proceeded with at once. If it is not too hard, it should be allowed to stand from 12 hours up, according to its condition, to give it a chance to "sweat" out and take on a hard surface on which to do the fine rubbing. While the fine rubbing in this case is done in the same way as on pianos, yet the object to be attained is somewhat different. When rubbing a flow coat of varnish there is a certain amount of grit to be rubbed off, and while doing so, one must keep the surface in condition for polishing. In the case under consideration, where one is fine-rubbing a surface that has been coarse-rubbed, the object is to prepare the surface for polishing by removing all the scratches made by the pumice. From 12 to 24 hours should always be allowed between the fine rubbing and the polishing to insure a durable polish. A longer time than this may be necessary unless the varnish is fairly dry.

WHEN TO DO FINE RUBBING.

In the opinion of the writer, the modern method of polishing is in every respect equal to the hand polishing still in vogue in some piano factories. Of course, in the modern method a great deal depends on the composition of the liquid used in the process. There are many formulas for making polish, but the following is one that has been tested for several years on high grade work. It produces a very high and durable polish with a minimum amount of labor.

FORMULA FOR POLISH.

1 gallon	Paraffine Oil.
1 gallon	Pure Turpentine.
20 ounces	Oil of Cedar.
12 ounces	Oil of Citronella.

The longer this polish has been made before using, the better it will do its work. It is used in connection with rotten stone in the ordinary way with a pad. A very soft cotton waste makes an ideal polishing pad. This polish is improved by the addition of a little water, but it cannot be mixed with the polish. Take a small handful of the cotton waste and thoroughly saturate with water, then wring as dry as possible. Rub this

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damp cotton waste over the surface to be polished immediately before commencing operations. This will supply the required water.

If a plain surface like a table top is to be polished, one should start at the ends, polishing these crosswise. This crosswise polishing is necessary in order to be sure of a high polish out to the extreme ends and it must be done at the outset otherwise the cross polishing will leave a mark. This polishing is not done with circular motions the way French polishing and hand polishing are done. The motion is a straight stroke extending from one end to the other of the surface polished.

POLISH PLAIN SURFACES CROSSWISE.

After the polish has been brought to the highest point possible by this process, its brilliancy may be deepened by rubbing rapidly with the bare hand using the least possible quantity of polish—just enough to prevent the hand sticking to the varnish. Rub with a circular motion the same as when hand polishing.

Clean the polish off with a soft cloth moistened with alcohol. The greatest care must be exercised in doing this. Have but a small quantity of alcohol on the cloth and go over the surface very lightly, using a circular motion. If there is too much alcohol on the cloth, it is certain to burn into the varnish and destroy the polish. Sprinkle a small quantity of the alcohol on the cloth and twist it up tightly. This will allow the liquid to spread itself throughout the whole cloth and reduce to a minimum the possibility of burning the varnish.

HOW TO MAKE SATIN FINISH.

To make a satin finish the varnish is rubbed down with water and pumice and then oiled. A finish a little more dull than satin finish is made by rubbing the varnish with oil and pumice. If goods are heavily coated, the large flat surfaces such as tops and fronts and other prominent parts of the work, should first be water rubbed and allowed to stand for a few hours before being oil rubbed. This will prevent "pulling out."

To make a dull lustreless finish that will withstand the extremes of any climate, hot or cold, moist or dry, proceed as follows:

After the work has been stained, apply a coat of

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very thin shellac. This shellac should not be heavier than 24 ounces gum to the gallon of solvent. When this is dry, sand smooth with very fine paper and put on three or four coats of pure banana oil. Sand the last coat well with fine paper, then wax. Banana oil is a very powerful solvent and must be applied very rapidly and with no more brushing than is required to lay it on. If more than this is done, it will raise the under coat.

TO PRODUCE LUSTRELESS FINISH.

It will not show laps or streaks when dry, so that fear of trouble from this source need not lead a man into brushing more than is required. If the oil becomes too thick for use, it may be reduced with alcohol or methylated spirits.

Banana oil dries without the slightest lustre. So lustreless is it that after several coats have been applied the surface still retains the appearance of bare wood. If a little lustre is desired, it may be obtained by making the shellac for the first coat heavier, say about two and one-half pounds of gum to a gallon of solvent.

The above makes a good finish for fumed and cathedral oak and other similar finishes. It is also suitable for carvings and pebbled work.

The dipping process in finishing is one that has found favor with several lines of goods, particularly turned spindle work such as piano stools, etc. On work of this kind much better results can be obtained, and with less labor, by the dipping process than by the brush method. To produce the highest quality of finish on stools suitable for the piano trade with but three applications after the stain is on, and that without any sanding of the turned parts, would have been considered impossible a few years ago, and is considered so today in not a few shops.

FINISHING BY DIPPING.

But it is among the every-day things of at least one shop, and the process is very simple. The walnut and mahogany finish are dipped in their respective stains and allowed to dry. (The wood is birch and the stains are water-stains.) They are then dipped in a very thin varnish or a cheap grade. This coat penetrates the pores and seals up the fine cells of the wood so that the liquid of the next coat cannot enter. When this is thor-

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oughly dry, a coat of pigment surfacer is applied. This surfacer is made as follows:

PIGMENT SURFACER FORMULA.

1 gallon Varnish.
1 gallon Brown Japan.
8 pounds Silex (very fine.)

This surfacer is brushed on and is the only brush coat the stools receive. It is put on full weight and as much of it put on as can be done safely without running. On turned stool legs there is much end wood and the surfacer covers the whole with a porcelain-like surface which holds the varnish out perfectly. When this surfacer is dry the flat tops are sanded. Then the whole stool is dipped in the varnish. It is allowed to drain, then the fat edge on the under side is cut off with a brush and the stool set away to dry.

The firm referred to manufactures a general line of sanitary woodwork, and much fine work is turned out polished in one coat of varnish. The goods are dipped in a large pan of filler. On large flat surfaces such as tanks, if the wood is oak, the filler is brushed a little to work it into the pores. One big advantage of filling the tanks by the dipping process is that it coats the inside with a water-proof substance, and does it much more perfectly than could possibly be done with the brush. Closet seats and other small articles are dipped and not brushed. Forty-eight hours are allowed between the filling and the surfacing. The surfacer used is made from the formula given in the chapter on Surfacing and Varnishing, and a good coat is put on. If the goods are to be shipped in the varnish gloss, the surfacer is allowed to dry 24 hours before sanding and varnishing. But if the goods are to be polished, 48 hours are allowed. The coat to be rubbed and polished is put on somewhat heavier than that for varnish gloss finish, hence the necessity for allowing the surfacer a longer time to harden that the varnish may have every possible chance. The surfacer and varnish are put on the tanks and seats with a brush.

NEEDS MUCH TIME FOR HARDENING.

In this factory two men and two boys will stain several thousand closet seats in a short time. The stain

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is used warm and takes hold of the wood instantly. It it kept warm by means of a hot water vat.

The vat is 30 inches wide by 60 inches long and 20 inches deep. Inside the vat is a frame 14 inches high. A steam pipe enters at one end and extends along the bottom to the other end of the vat. The end of the pipe is closed, but along the side are about a dozen one-sixteenth inch holes for the steam to escape. There is also an overflow pipe, two inches from the top.

HOW MUCH STAINING MAY BE DONE RAPIDLY.

The stain pan, which is six inches deep and made to fit the inside of the vat, rests on the frame. The vat is filled with water to the top of the overflow pipe and the steam turned on. This overflow pipe is necessary to carry away the condensed steam. If a coil with a return pipe were used the overflow pipe would not be necessary, but it would require more steam. When the water in the vats heats, the stain soon becomes warm, and as it is surrounded on the bottom and all four sides with water which comes up the side four inches, it is kept warm as long as it is in use.

A wire hook is used for dipping the seat in the stain. The seat is placed on the hook and placed in one end of the stain pan, then drawn rapidly through the stain to the other end, then lifted out and set in another large pan to drain. They are then taken out and placed in racks made for the purpose.

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CHAPTER XLIX.

VARNISHES AND THEIR DRYING.

IN RECENT years it was found that the finishing room equipment was falling behind. It was the one department that consumed the most time in obtaining results. Efforts to make quick drying varnishes, surfacers, etc., did not meet with the demands. One reason why wax finishes were heralded was because they could be turned out quickly. Years of experiments were made in an endeavor to find methods which would attain the desired end.

DEMAND FOR QUICK DRYING.

It has been known a long time that weather and atmospheric conditions are of vital importance to the drying process in the finishing room. Summer as well as winter months carry with them difficulties which cause delay and uncertainties in the finishing room. The importance of this is appreciated when one considers the results that will follow when any under coat of stain, filler or varnish is not thoroughly dry when the following coat is applied.

On a damp, humid day, the grain of the wood raises very perceptibly, as compared with a clear, dry day, making the surface to be coated uneven, and destroying much of the effect of fine sanding, thus starting the finish under a disadvantage.

THE CAUSE OF MUSHY COATS.

Stains and fillers will not dry as well as under favorable conditions, and especially when oil stains are used the filler is likely to cut into the stain, producing a mushy condition in the filler. If followed by the first coat of varnish on regular schedule, the varnish will have a similar tendency to cut into the filler, causing in turn a mushy coat of varnish, which will not dry hard and firm as under favorable conditions, and this condition will prevail through all coats to the finishing coat of varnish. As a final result, none of the coats being as hard as under good conditions, the finish is comparatively soft; a polishing varnish will not take as bright a polish and will rub and polish harder; gloss, rubbed

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or polished work will often develop sticking or printing troubles, and at a later date the gradual drying of these mushy undercoats will draw in the finish coats producing loss of lustre and finish, or shrinkage. During such conditions the finishing materials are usually blamed for the disruption of finish or finishing schedules, when the drying condition of the atmosphere is the sole cause.

VARNISH DRYING DEPENDS ON SOLVENTS.

Considerable quantities of fumes are thrown off by the drying of finishing materials, and we all know that varnish drying depends upon the evaporation of the solvents in the varnish, and of the oxidation of the gums and oils. Experiments have shown that humidity and temperature are two factors which should be controlled in the drying process.

This condition is based on the scientific fact that the capacity of warm or hot air to carry humidity or moisture is enormously greater than that of cold air. For instance, air at 60 degrees Fahrenheit is completely saturated when it carries 4.8 grains of moisture per cubic foot; whereas, air at 100 degrees Fahrenheit requires 19.8 grains of moisture per cubic foot to saturate it. Thus, although the temperature has been increased from 60 to 100 degrees, or 66⅔ per cent, its capacity for moisture has been increased from 4.8 grains to 19.8 grains per cubic foot, or 412.5 per cent.

Humidity is expressed relatively in terms of per cent of saturation, which is 100 per cent. Air at 100 degrees with 40 per cent humidity carries 7.9 grains of moisture per cubic foot, which is 40 per cent of 19.8 grains, the saturation or dew point.

BEST DRYING CONDITION 35 TO 45 PER CENT HUMIDITY.

Practical experience indicates that the best drying condition of the atmosphere at any temperature is with humidity of 35 to 45 per cent, although satisfactory results have been secured at both higher and lower percentages. With a low humidity, however, there is a tendency to top-dry or case-harden, especially at a temperature above 100 degrees. With a high percentage the effect is to retard the oxidation or drying of varnish. Humidity is determined by means of a hygrodeik, or "wet and dry bulb thermometer."

The atmosphere normally has an average humidity of 60 to 70 per cent. When the percentage increases,

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due to natural causes, it often reaches saturation or 100 per cent, at which point the excess is precipitated in the form of rain.

The experiments conducted brought forth many patented schemes such as varnish drying kilns, ovens, and drying rooms. They were the results of experiments by varnish makers, and were based upon three vital points necessary to varnish drying: First, the constant circulation of fresh air, meaning the continual presence of the drying agent, oxygen; second, heat, and third, humidity. These three held under automatic control at the will of the operator produced the best results.

THREE POINTS NECESSARY TO VARNISH DRYING.

It is generally accepted as a result of practical operation that the temperature at no time should exceed 120 degrees, it being understood that the humidity should be at a desirable point and under control, and in the presence of continual circulation of fresh air, without a direct draft on the work.

It has been proven beyond doubt that there is a limit to the time in which work can be coated, dried in a varnish drying system and recoated, with best results. It has been conclusively shown in practical shop operation, too, that as a general proposition, the varnish that gives the best results under old air drying schedules will give the best results in use in a varnish drying system.

In the cool months of the year, the outside air, being at a low temperature, carries a very small amount of moisture, as described above. In this condition, it is brought into the factory or finishing room and heated to 75 to 90 degrees, the result being that its capacity for carrying moisture, having thus been increased by raising its temperature, the percentage of humidity is lowered to anywhere from 25 per cent to 40 per cent, depending upon the temperature and humidity condition of the outside air. This is a very desirable condition for drying varnish and other finishing materials.

DESIRABLE CONDITION.

During the warm months, the condition is just the reverse. The outside air being hot, carries a relatively large amount of moisture per cubic foot, as described above. It is brought into the finishing room at the same temperature and in the same condition, and as the

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temperature generally falls at night, its percentage of humidity is thus further increased, producing an extremely bad drying condition.

There is nothing that will give the desired results better than conditioning the entire finishing room, thus making the entire room practically a varnish drying room. By this we mean making provision in radiation for raising the temperature to 100 or 110 degrees every night during the year and providing adequate means for a constant circulation of fresh air, which can be done by the proper ventilators, or a fan, or both. Such an arrangement is both practical and economical in the majority of shops, and in any event the manufacturer should provide for and have heat in his finishing room every night the year round, for reasons which have been explained.

FINISHING ROOM SHOULD BE CONDITIONED.

This can be accomplished by placing the heating coils or hot air pipes along the outside walls underneath the windows, and having ventilators take air from the center of the room and extend down to within a few inches of the floor. Hot blast pipes or heating coils should not be near the top or center of the room, as such a location of the heating pipes or coils will prevent good circulation and increase the expense of heating. The heat should be turned off at three or four o'clock in the morning to allow the room to cool off and the filler or varnish to harden before the workmen commence work for the day. Suppose the outside atmosphere was 80 degrees with a humidity of 85 per cent, which would be a very hot, muggy day and an extremely bad drying atmosphere. By raising the temperature of the finishing room to 100 degrees at night, the percentage of humidity would be reduced thereby to 46 per cent, which is considered an excellent drying condition.

SUCCESSFUL METHOD FOR DRYING PURPOSES.

A successful method for drying purposes, which is installed in many factories, is the setting aside of certain rooms in which the temperature is continually maintained by means of steam coils over which is drawn fresh air. The room is provided with exhaust fans expelling the loaded air and causing a continual change of atmosphere, producing an ideal drying condition which will result in many hours saved in time.

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CHAPTER L.

JUST HOW VARNISH IS MADE.

VARNISH is composed of three essential ingredients—gum to give hardness and lustre—oil to impart elasticity, and a solvent or thinner to keep it in a liquid state. After the varnish is applied, the solvent evaporates and the coating of gum and oil remains behind—thus these two materials have the most important bearing on varnish quality. There is also another ingredient present in almost all varnishes —"drier," usually composed of lead and manganese. It is almost invariably added to the oil before the varnish is made and varies according to the kind necessary to produce required results.

INGREDIENTS OF VARNISH.

Fossil gums are used for the best varnishes and are the hardened sap of trees that lived thousands of years ago. The sap ran upon the ground, hardened, became covered with decayed vegetation and fossilized. Today it is found several feet below the surface of the earth. The gum known as kauri is the chief and most widely used. There are so many grades of each kind of varnish gum that it means absolutely nothing to one when a manufacturer claims that he uses a certain kind of gum. For instance, kauri gum varies from 14 to 80 cents a pound. So you see that it is not what the manufacturer says is in the varnish that counts, but the quality of the materials and, most of all, what the varnish will do.

TWO OILS ARE UTILIZED.

The oils used for varnish making are chiefly linseed oil and china wood oil, especially prepared and well aged. The solvent is chiefly turpentine.

In the manufacture of varnish, the varnish maker first melts the gum over a coke fire in a copper kettle. When the gum is properly melted, the oil which is hot, having been separately heated, is added. The critical point in the entire process of varnish making is to tell the exact moment to add the oil to the melted gum, and experience alone can tell. If the gum is melted too

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long, it becomes dark in color; if underheated, it will be paler, but will lack durability.

After adding the oil, the gum and oil are heated together until the two are thoroughly combined, when the kettle is withdrawn from the fire. The kettle is next taken into the thinning room where the mixture is allowed to cool to a certain temperature, and the thinner or solvent added.

PROCESS OF MANUFACTURE.

After thinning, the varnish is pumped through a pipe to a vat or cooler where, besides cooling, it settles and becomes clearer. From the cooler the varnish is passed through a filter press which removes all the dirt and foreign matter. The varnish is next pumped to the aging tanks where it is allowed to thoroughly ripen. This aging makes the varnish bright and clear.

The tough oil varnishes are in greater demand than the spirit varnishes, although the defects in oil varnishes are numberless. How often a person sits on a varnished chair and on rising finds the loose nap from his clothes sticking inseparably to the chair and the print of the weave of his clothes left in the soft, tacky varnish. Cases have come within the writer's observation where the fine fabrics in ladies' dresses have been torn on being drawn from the sticky or "tacky" varnish. Cheap contract varnish, such as is often found on church pews and public benches generally is likely to show this undesirable quality. These varnishes have incorporated in them non-volatile, non-drying oils such as the heavier mineral oils. These oils do not oxidize and dry to a solid elastic mass, as drying oils do, and as a consequence, the varnishes remain "tacky" for an indefinite time and practically never dry. There is no remedy for this defect but to cut off the poor varnish with some solvent such as one quart acetone, one quart alcohol, one-half pint of water saturated with washing soda and one quart of benzine, in which a few ounces of paraffin or other wax have been melted. The mixture should be well shaken and then brushed over the surface until the varnish is quite wet. To prevent evaporation, cover over the article with old sacks and let it stand for 20 minutes, giving time for the solution to soften up the varnish. On

EVIDENCES OF POOR VARNISH.

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removing the sacks, the varnish will be found very soft and easy to wipe off with a rag or to scrape off with a straight piece of glass or steel. When the article is cleaned and wiped thoroughly dry, revarnish with a good linseed oil varnish. The recipe just given will remove any varnish whatsoever whether old and hard or soft and sticky.

REMOVING VARNISH.

Sweating of varnishes on damp, warm days is due, in many cases, to the presence of fish oils. These oils absorb moisture which causes the varnishes to become clammy and sticky to the touch, if the temperature is above 80 degrees Fahrenheit. The presence of oils having the power of absorbing water accounts for the excessive dews which collect on freshly varnished boats and canoes beached on an open shore of a summer's night.

Good varnished furniture is the bane of every one who possesses it. It is "so easily" scratched, and scratches cannot be mended. Scratching will never be eliminated from furniture until a harder and tougher varnish is discovered. Scratches which appear white cannot be obliterated easily. They may be obscured, however, by rubbing well with a piece of cheese cloth moistened with a solution of nine parts linseed oil and one part lemon oil. Any failure to have this solution work correctly will arise from the fact that too much oil has been applied to the surface and the rubbing has not been sufficient.

WHITENING OF VARNISH.

Whitening of varnish in the presence of water, for example, on the bottom of a canoe, is due to the absorption of water by the varnish, especially those low in good resins, and may be corrected by allowing the varnish to dry thoroughly in the open air (sunlight). This treatment causes the water to evaporate and restores the original appearance of the varnish. A spar varnish (that is, one high in resins) should then be applied to the thoroughly dry surface. If the surface is not allowed to dry thoroughly before the new coat of varnish is applied "blooming" will be the result, that is to say, the varnish will have a dull, smoky appearance like the bloom on a ripe blueberry.

Every one has observed minute hairlines on highly

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HAIRLINES ON PIANO FINISH.

polished varnish surfaces, such as piano cases. This hairlining is the first stage in the cracking of the varnish, and as the cracks widen the surface takes on a resemblance to alligator leather. This hairlining or cracking of varnish is caused primarily by too little oil being used in the varnish, or as varnish makers term it, "a short oil varnish" has been used. The lack of oil allows the varnish to dry in a short time, perhaps not longer than eight hours, but the coating is brittle and soon hairlines and these lines in time widen into unsightly cracks. Excess of cheap resins, such as rosin often causes these defects to appear in varnished surfaces.

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CHAPTER LI.

WHAT CONSTITUTES A GOOD VARNISH.

A GOOD varnish has good body, sufficient to give good lustre, yet not so heavy as to work badly and dry unevenly. It works smoothly under the brush and spreads in a thin, even coat, free from streakiness, still has sufficient consistency. It is elastic when dry and will not crack. It is durable and for outside work particularly indifferent to the effects of moisture and atmospheric conditions. It adheres tenaciously to the material to which it is applied. It is of good color that will not darken on exposure. A good varnish is good only for its particular purpose, as a varnish "long in oil" is intended for exterior work, floors, etc., while a varnish "short in oil" is intended for inside trim work. The safest method is to use the varnish which a reliable manufacturer recommends for a given purpose, for that purpose.

HOW GOOD VARNISH WORKS.

How may varnish be tested? Varnish may be tested for paleness by placing a small quantity of it in a thin glass vial, and comparing it with any standard sample, by holding both samples to the light.

Varnish may be tested for wear by applying two coats to two pieces of well dried, carefully sandpapered, newly planed wood. One piece of wood should be coated with the standard sample—the other piece with the varnish to be tested. Place both pieces of wood in an exposed exterior situation and note from time to time the appearance of the work. The piece which loses its brilliancy and cracks in the shortest time has been coated with the inferior varnish. Of course by this test, you must compare two varnishes intended for the same purpose, such as two interior varnishes, etc., and not two entirely different varnishes as an exterior varnish and an interior varnish.

VARNISH TESTS.

Another simple test is to revarnish any suitable surface with the suspected sample, and when the varnish is thoroughly dry, rub it quickly with the finger. If

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the new varnish crumbles up quickly, it evidently contains an inferior gum or most probably a large proportion of rosin. A good copal varnish cannot be removed in this way. A method of testing varnish for elasticity is to apply two coats of it to a sheet of linen and after it has properly dried, try its flexibility or tendency to chip off by crumbling between the hands.

HARDNESS OF VARNISH.

This question of hardness of varnish is so important that Dr. A. P. Laurie some time since patented an instrument, the principle of which was simply that of scratching a dried and varnished surface by means of a steel point.

The apparatus enables accurate readings to be taken, and it has been found that a fine carriage varnish will withstand a pressure equal to 1,200 grains, fairly good common varnishes 700, rosin varnishes 200 to 400, and spirit varnishes only a pressure of 100 grains.

Thus we see why it is that the latter are bruised with even a light blow, while the best carriage varnishes will withstand a considerable force.

The odor of varnish gives some information as to its quality, while the time taken to harden the degree of flowing and working under the brush yields useful information.

It may be added that it is the opinion of Dr. A. P. Laurie, based upon the experiments he has conducted with his instrument, that the best oil varnishes do not attain their maximum hardness until 12 months after they have been applied.

TEST IN ROOM OF 60° F.

The question of brilliancy of gloss I have not entered into, as this will be sufficiently obvious in comparing several grades of varnish. It will be best to conduct these experiments in a well ventilated room heated to a temperature of about 60 degrees.

A very hot room containing moisture-charged air is not suitable, as the conditions are adverse to the varnish properly drying, and may yield erroneous conclusions. There are many more tests which could be made, but they mostly involve the use of heat, or some appliances which are not at hand.

In writing this chapter I have kept steadily in mind

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the fact that the user is not so much interested in the chemical constituents of the material that he uses as he is in discovering whether they are genuine, and particularly whether they will do the work for which they are intended.

Never use spirit varnish, or enamel in which spirit varnish is used, for high class work requiring durability. While such goods dry quickly, they work very hard under the brush, requiring more labor to apply than does a high grade varnish, or an enamel made with a good oil varnish. Brush marks and laps show plainly. Furthermore, such materials have but little durability, being made from soft gums. After the solvent evaporates, the only coating left on the surface is the weak, brittle coating of gum with nothing to bind it to the wood. As a result, it soon chips off. The chief use of spirit varnishes is in cheap cabinet work where the main object is to get the work out quickly and procure a finish that will last long enough to sell the goods.

AVOID SPIRIT VARNISH IN HIGH CLASS WORK.

Oil varnishes made from good hard gums, pure linseed oil and turpentine, are the most durable. After the thinner evaporates, it leaves a hard, tough coating of gum and oil behind, that adheres to the wood; this is due to the hardness of the gum and the elasticity of the oil, which also binds the coating to the wood.

An English work on varnishes gives the following points on brilliancy and lustre: "Brilliancy and lustre depend on the nature of the resin. The greater the ratio of resin to oil, the greater is the brilliancy and lustre of the varnish. As a matter of fact, the brilliancy of a varnish is a property dependent on its index of refraction. As the index of refraction of a resin is greater than that of linseed oil, the more resin there is in a varnish the more lustrous it is. Hence the reason why spirit varnishes, after drying, are more lustrous than oil varnishes. Each unit per cent of oil in the dried coating of an oil varnish diminishes its lustre pro rata. On the other hand, even if it increases the lustre proportionately, each unit per cent of resin in varnish, after a certain amount, diminishes its durability pro rata. A compromise, therefore, has to be made according to the object in view in designing a

BRILLIANCY AND LUSTRE.

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varnish for any given purpose. Where brilliancy is a desideratum the resin must not be less than one-third to one-fourth by weight of the dried coat. But where brilliancy leaves off, durability is only beginning, and varnishes, in which the resin only forms one-fourth of the dried coat, are used where great elasticity is demanded. In the case of a piano varnish, for instance, durability, to a certain extent, is sacrificed to lustre, and the percentage of resin to oil preponderates in such a varnish. The harder the resin, the greater the brilliancy. A manila varnish made with the same number of gallons of linseed per 100 pounds of manila is less lustrous than one made in the same ratio of oil to resin from zanzibar copal. It is asserted that the index of refraction of a varnish is greater than that calculated from its composition, but this may be due to a turpentine residuum left out of the calculation. Be this as it may, the skill and care with which a varnish is made are factors which cannot be lost sight of in any investigation into the cause of the brilliancy of varnish.

DURABILITY SACRIFICED TO FINISH.

Durability and resistance will vary with the proportion of linseed oil and the elasticity of its oxidation product. Varnishes should embody the brilliancy of the resins and the elasticity of the drying oils.

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CHAPTER LII.

PROTECTION IN BUYING VARNISHES.

THE day of the varnish salesman and the foreman finisher getting together over the purchases of varnish has passed. The salesman now enters the business office to show his wares. If there is an inclination to buy of his house he is requested to send a gallon, and it is tested out. The foreman and the purchasing agent will make a physical test of the sample received. An eight ounce bottle of the sample is hermetically sealed and laid away. The balance is used in a practical way on pieces of furniture which are marked and dated, and put through subsequent operations in the regular manner, the result of the finish being noted in each stage.

VARNISH SELLING METHODS CHANGED.

One manufacturer proceeds as follows: He keeps a supply of boards in his finishing room of the wood used most in his plant. The boards are six inches wide and 24 inches long. They are put through the various finishing processes until they reach the point where varnish is required, whether it be the first coat or the polishing varnish. Usually three sample boards are used, one-half of which is covered with the old varnish in use, and the other half with the sample varnish. The pieces are left to dry for 10 days, and are then taken to the roof where a large rack has been erected to hold them. They are given a southern exposure at an angle of 30 degrees. The pieces are looked over regularly, morning and night, and records are kept of changes and conditions. The boards are thus exposed to all kinds of weather until the varnish shows checking or crazing, when it will be noted whether the checking or crazing comes to both varnishes at the same time, or to which it came first.

TESTING BEFORE BUYING.

The manufacturer of furniture is not looking for a varnish that will stand up indefinitely under all forms of weather, but he does learn that a certain varnish will stand exposure to snow and rain in winter months

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with no indications of checking or crazing for over 350 hours, and when rubbed and polished in the finishing room will reveal a finished surface equal to anything in the factory. He seeks a record by which all the varnish from a certain concern may be judged. This can be done by three tests: Specific gravity, viscosity and the flash tests.

GRAVITY, VISCOSITY, FLASH TESTS.

Specific gravity of varnish is its weight compared with an equal quantity of water, which is 100. A bottle which will hold 100 grams of water is filled with varnish at 70 degrees F. The bottle is marked with its own weight. The bottle of varnish is weighed on scales graduated down to one seven-thousandths of a pound, and if the varnish is all right the register will show the specific gravity is from 80 to 90 compared with an equal amount of distilled water. If the varnish manufacturer has introduced substitute oils or gums there will be a change in the specific gravity for the reason that no two different oils or gums have a like specific gravity.

Viscosity of liquids is determined by the length of time it takes a certain quantity of it to run through a certain sized hole compared with the time it takes the same quantity of distilled water to run through the same hole. Knowing the time required for 50 cubic centimeters to pass through a certain hole in a viscosimeter (various styles of which are on the market), and knowing the length of time required for a like amount of varnish to pass through the same hole, both liquids being at the same temperature, the viscosity of the varnish is easy to determine.

DETERMINING VISCOSITY.

For example: We have a viscosimeter with a water figure of 10.2, which is the time required for 50 cubic centimeters of distilled water to pass through the hole at the bottom of the cup. The same amount of varnish at 90 degrees requires 153 seconds to pass through the same hole. We therefore divide 153 by 10.2, which leaves an answer of 15, or which means that the varnish is 15 times thicker than water, and therefore has a viscosity of 15. As with the specific gravity, the viscosity will vary with any change made in the manufacture, or in materials used in the making of varnish.

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The flash test is used to determine the drying quality of a varnish. A small iron pot is used, one and one-half inches in diameter and two inches deep. This is surrounded by a water jacket and set on legs eight inches high. The cup is filled with varnish of 70 degrees temperature, and the temperature is gradually raised by an alcohol lamp. From time to time as the temperature is being raised a lighted wax taper is brushed across the surface one-half inch above the varnish. A thermometer in the varnish will indicate when the varnish has reached the point where it will flash, that is, when the fumes will catch fire as the lighted taper is passed over the top. Then the temperature should be noted, which should be in the neighborhood of 98 degrees. This is the flash point, and any higher or lower flash point indicates that a slower drying oil has been used or the varnish contains some drier.

USE OF THE FLASH TEST.

The results of these three tests do not necessarily indicate poor varnish, but they enable the purchaser to keep records and determine whether the new varnish offered him is better for the money than the quality he has been using.

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CHAPTER LIII.

SOME TROUBLES WITH VARNISH.

BLOTCHING—This is sometimes called "pinholes," "pocking" or "pitting," and generally results from reducing the varnish with turpentine or some other poor thinner which is not thoroughly mixed with the varnish. It may also result from coating over an oily or damp surface.

COMMON FAULT OF VARNISH.

SINKING OR DEADENING—This generally follows the use of insufficient foundation coats; or it may happen when one coat is applied before the undercoat is thoroughly dry, so that the top coating is absorbed while drying.

CHIPPING OR FLAKING—This is often caused by using brittle varnish for first coats or by using varnish of varying elasticity.

CHILLING—Naturally this occurs only in cold weather. Long or extreme exposure to cold often causes varnish to "speck."

CRACKING—Brittle varnishes crack under severe changes of temperature. Cracking occurs also when a finishing coat is applied over heavy undercoats that have not thoroughly dried, or when a brittle coat has been applied over an elastic one.

CHECKING OR CRUMBLING—Exposure to coal gas or ammonia fumes will cause this trouble as will also washing with hot water or alkaline soap.

THINGS TO AVOID IN VARNISHES.

CRAWLING—This may be caused by using too heavy coats, or by finishing before first coats are dry, or by the quick changes in the weather while drying.

BLOOMING—This is most likely to happen with a quick drying varnish which does not carry oil enough to resist the action of moisture or of various fumes and gases, or with a varnish in which the oil and gum are imperfectly amalgamated.

BRITTLENESS—If a varnish "nails" white it shows the presence of poor material such as rosin, with too

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little oil and too much drier; such varnish is hard to apply and does not wear well.

SWEATING—A varnish coat is likely to sweat whenever rubbing is attempted before varnish is sufficiently dry.

BRUSH MARKS—This trouble results from working the varnish too long or from the use of a brush too small.

MORE FAULTS THAT ARE COMMON.

DRYING AND HARDENING—For varnish to dry and harden properly requires light, ventilation and moderate temperature. Very hot weather, very cold weather and humidity all interfere with drying. Best results are gotten in dry atmosphere and a temperature ranging from 65 to 80 degrees Fahrenheit.

If the above suggestions are carefully looked into, many difficulties can be overcome. By all means see that the cans are well corked; that the stock is kept in even temperature; avoid extreme changes. Varnish changes with age, and especially does it do this when it is exposed to atmospheric conditions.

DRYING FROM BOTTOM UP—Drying from the bottom up, or drying from the top, means the difference between the surface drying of boiled oil and the more uniform drying of raw oil containing driers, as in paint. Taken literally, the statement is incorrect, because oxidation or drying must occur at the surface of the paint or varnish, and not at the bottom; but the term "drying from the bottom up" indicates, as stated, a certain process that is different from the usual drying of paint or varnish or plain linseed oil that is a strong drier or has driers added to it.

REFINISHING PATCHY WORK.

In refinishing a piece of varnish work that is patchy it is first necessary to get at the actual trouble. It may be caused from imperfectly prepared groundwork, an admixture of raw linseed oil to varnish, or incompetent brush work. First smooth down with pumice stone and water; prepare with a mixture of equal parts varnish and turpentine, and revarnish. Lay on a good full coat of varnish freely and quickly, working this again once or twice all over without recharging the brush, thus taking off again some of the varnish, occasionally rubbing this out on another part of the work.

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CHAPTER LIV.

VARNISH TERMS IN FINISHING ROOM.

SHOP TERMS FOR VARNISH.

RUBBING VARNISH—A varnish that is hard, brittle, one that when subjected to rubbing with pumice or rotten stone will yield a high glass-like polish. It must not soften with heat, generated by friction, nor be affected by either oil or water in the rubbing process.

POLISHING VARNISH—Having the same practical points as rubbing varnish but usually capable of giving a higher polish.

DIPPING VARNISH—As the name implies, a varnish that will dry quickly, giving a polished surface, avoiding the labor of applying by hand; they are usually much thinner than other varnishes.

FLOWING VARNISH—A varnish that will produce a smooth shiny surface without any after-treatment. A varnish of this kind must spread readily and evenly, and when dry will be devoid of any brush marks.

FLAT VARNISH—A varnish that, as the name implies, will dry flat or with a matte surface.

PIANO VARNISH—A high grade varnish that will produce a high polish; an exceptionally hard surface, that will withstand polishing.

SHELLAC VARNISHES—By the term "shellac" is implied an alcoholic solution of gum shellac. This may be either grain alcohol, wood alcohol, or denatured alcohol. Usually three to three and half pounds of gum are cut in a gallon of alcohol. Ofttimes called Liquid Fillers, because they form an impervious coat between the wood and the varnish. Dry quickly, enter the pores, and sand readily.

DAMAR VARNISH—So named from the gum, usually cut in turpentine, and sometimes in spirits. It is recommended in certain places where extreme paleness and transparency is desired. Ofttimes used on dainty articles and subjected to French polishing.

FINISHING COAT—As the name implies, it is the

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last coat of varnish used in the finishing of work. It may be the first coat, on top of a shellac coat; it may be the third coat on furniture, and the final coat on pianos, usually selected for its qualifications as to the style of finish desired.

BAKING VARNISH—One that is used where drying ovens are employed. One that is made by the manufacturer to dry in unnatural heat usually containing more oil, having advantage of being more durable, owing to the fact that the drying process to which it is subjected produces a more uniform film.

OTHER NAMES FOR VARNISH.

SPRAYING VARNISH—Does not differ materially from regular stock varnishes, with the exception that as a rule, they are thinner, and obtain their name from the fact that they are applied with spraying apparatus.

LONG AND SHORT OIL VARNISH—These terms as used by the finishers apply to the proportion of oil and gum. One is exemplified by the rubbing varnishes, and the other by spar varnishes; one drying much slower and having more elasticity, and the other drying harder and permitting of rubbing to a high polish.

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CHAPTER LV.

PRODUCTION AND ADULTERATION OF SHELLAC.

MY laboratory experiences have convinced me that it is the maltreatment which shellac receives which entails the difficulties which may arise through its use. This is not always the case, but when shellac goes wrong, it is usually due to an inferior quality, having been used by the operator unwittingly, or through the careless handling of the stock before it is used. That it gives a brittle coating is conceded; that it is not the best first coater in all cases is also conceded. Where the time limit comes into play, there is nothing which can compare with shellac. It is the oil rubbing that gives the life and wearing qualities to the shellac, and further, it depends upon the quality and the number of coats applied. We know what French polish does; we know that it is a mixture of shellac gum, alcohol, and oils, and these evidently wear very well, as they still are recognized as par-excellence. So there will be no misunderstanding, let my reader take two pieces of furniture which have been filled alike and prepared for the first coater, and let them be treated as follows: Let one be given the regular first coating with shellac, the other given a coat of varnish without any first coater. Let each then be finished up with two additional coats of first-class varnish, oil rubbed and finished. The piece with the shellac first coat will show a bruise by discoloration on the bruised spot, whereas the one which has but the varnish coating will merely show an indentation.

CONSIDERING TIME LIMIT NOTHING BEATS SHELLAC.

Now, the writer is inclined to believe that the defect in the experiment in which the first coater was used did not result from the inferior qualities of shellac, and the difficulties that the manufacturer was having with shellac. The fluctuation of the shellac market, the consequent endeavor of the shellac manufacturer to hold the price uniform, result in adulterations of the article. The houses supplying shellac, and in using the

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word "shellac," I mean the article ready for the brush, may have sought the assistance of the manufacturing chemists, and found that a shellac varnish could be made by substituting as high as 25 per cent of rosin without materially affecting the drying time of the shellac. Dr. H. W. Wiley rightly says that adulterants are not incorporated to lessen the price to the consumer of the genuine article, but rather to increase the profit. Rosin is not added to shellac varnish to increase its quality, but it is added to decrease the cost.

ADULTERATING SHELLAC TO DECREASE COST.

Let the reader do a little figuring. Say that one pound of pure gum shellac is worth 25 cents, and one gallon of 97 per cent wood alcohol is worth $1.00, and a pound of rosin is worth 2½ cents. Now, then, we will make a gallon of shellac, or better, we will take a gallon of alcohol, and add to it four pounds of gum shellac at 25 cents per pound. The resulting quantity, when it is all dissolved, will be better than a gallon, but it will have cost us $2.00. Now, then, take another gallon of alcohol, add three pounds of gum shellac and one pound of rosin, and the resulting quantity will have cost us $1.77½, a difference of 22½ cents. Who gets that 22½ cents? If the one that gets it is willing to divide, he may save the consumer, but it is fair to believe that if the consumer gets any saving, the major portion goes to the fellow that got up the idea of putting the rosin, usually without informing the consumer, into the varnish.

CONSUMER DEMANDING BETTER GOODS.

This is an age where we are getting down to a more solid basis. Heretofore, the producer had on his side the chemists and experienced people. Today it is becoming a different proposition. The consumer has been awakened. Railroads have their testing laboratories, and they buy their supplies on the say-so of their own investigators, and so it is that these discussions are only forerunners of getting things down to a better basis, for as soon as the consumer is apprised of something unknown to him, he is going to have his eyes open, and he is going to look into matters from a different angle. It will result and act as a warning to the flagrant substituting and adulterating manufacturer. A result of this has been the new law which prohibits the

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sale of turpentine substitutes unless they are so labeled, but as long as the trade finds no fault, the manufacturer will continue until he works his own ruin, and this he has partially succeeded in doing by the continued reduction of the quality until the trade has sought something else, and created a demand which brought forth the first coaters by the varnish houses.

It is safe to say that shellac is not thoroughly understood. Nor are its peculiarities known to the furniture manufacturer. Reference books tell us that lac is a resinous incrustation excreted by a scale insect known variously as Tachardia, Coccus, or Carteria Lacca. The insects infest the young branches and twigs of various Asiatic trees, especially figs, and excrete resinous and coloring matter under which they become buried, often to the depth of more than a quarter of an inch. They are often so numerous at times of migration that the twigs seem to be concealed by red dust. In Northern India and Assam the production of lac is fostered by hanging infested twigs in non-infested twigs, and regular collections are made each autumn and spring, the former being of greater commercial importance, the latter mainly for propagating purposes. Trees in ordinary vigor are considered best, and are said to furnish six or eight crops before being given a rest, though some trees may yield more than 20 crops.

SOURCE OF SHELLAC.

Two methods are commonly employed in preparing lac for market. In the commoner, the twigs are broken or powdered and thrown into and kneaded in hot water to melt the resin, dissolve the coloring substance and separate the dead insect remains and wood. Several alternate washings and dryings follow in order to have the resin as free as possible from coloring matter. The dried lac is then suspended in coarse cotton sacks before charcoal fires. The bags are twisted to force out the resin, which is caught in films upon pieces of wood upon which it hardens and becomes commercial shellac. The finest quality is a light brown or deep orange. Imperfect removal of the coloring matter results in dark colored lac. Button lac and plate lac are merely the drops of various sizes which missed the sticks and fell to the ground. The lac that falls to the ground from

PREPARING FOR MARKET.

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the trees is collected and sold as seed lac, a name also given to the resin before it is fused, but after it has been purified by washing. The first water mentioned above is strained and evaporated, the purple pigment cut in cakes and marketed as lac dye. The other process of purifying the crude lac consists in crushing between rollers, mixing with water, stirring in a cylinder, precipitating the coloring matter with lime, removing the lac, withdrawing the water, pressing the precipitate into cakes and drying them in the sun. The resin in this process is melted by steam heat poured upon tilted flattened zinc tubes filled with warm water. After cooling it is marketed. Lacs are prized because of their varnishing properties, because they can be highly polished when dry and because they are translucent and in some of the finer grades transparent, thus allowing the grain of the wood to show clearly through them.

ANOTHER PROCESS OF PURIFYING LAC.

Were it not for shellac, French polishing would be impossible, the finest finishes being produced by the use of shellac and oil rubbing. In the days before varnishes were made, we had lac and we had oil, and above all, we had time. With these three elements incomparable, pleasing and soft-toned finishes were made. In the Orient, shellac is the basis.

The idea in the modern use of shellac is to get a quick coat over the filler and stain. In this way, at least one coat of varnish is eliminated and a great deal of time saved because the shellac dries within a few minutes. A perfect shellac varnish should dry in six minutes, and should be ready to sandpaper in 30 minutes. The second coat should dry in seven or eight minutes and in a few hours be ready to sand. The third coat should be ready to sand in 15 to 20 minutes and in one or two hours' time ready to rub with oil. Shellac that will work in this manner is usually made out of D. C. or V. S. O., these two brands being considered the best grades of shellac on the market. At the present time we have three solvents for the gum: Grain alcohol, wood alcohol and denatured alcohol. Grain alcohol is unquestionably the best, but it is prohibitive owing to the price. Therefore, we have denatured alcohol which contains a small percentage of naphtha. At any

MODERN IDEA OF USE OF SHELLAC.

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rate, the solution should contain at least 95 per cent of alcohol, as a lower grade alcohol will not dissolve the gum and owing to the presence of water, will dry slowly.

To know the nature of shellac would be to obviate the many difficulties that arise in its use. Above all, to realize the affinity that alcohol has for water, would safeguard shellac varnish from the many abuses to which it is inadvertently subjected. The affinity of alcohol for water is so great that if only a very little water is added to the solution of alcohol shellac the water will combine with the alcohol and a corresponding amount of shellac will precipitate and separate from the solution. To convince the reader, let him take a bottle of shellac and let him note how this will change provided he leaves it subjected to the atmosphere in an uncorked bottle. Shellac troubles are usually had during the rainy season, especially in factories where white shellac is employed. It is stated by authority that about four-fifths of the shellac varnish made in this country is adulterated.

SAFEGUARDING SHELLAC.

Formulas are given showing the use of acetone, sulphuric ether, orange shellac and rosin. A shellac varnish in which 25 per cent of the gum has been substituted with rosin will show no difference in the drying quality, but it will not give as hard a finish as the pure shellac varnish. If this rosin shellac is carelessly handled, it will dry slower; for instance, if the stock of shellac is kept in a wet basement, where it is but loosely corked, it will deteriorate quicker than if it were made of pure shellac only. The adulterant, it will be seen, acts in two ways—first, that the varnish is not as good, and second, that it increases the affinity for water.

ADULTERANT ACTS IN TWO WAYS.

The most trouble is noticed in white shellac where one or two coats of shellac are applied, a milky coating is the result. White shellac, which is nothing more than the orange gum bleached, and which is more expensive owing to the bleaching process, is also more apt to be adulterated. It is also apt to contain a small percentage of water. Whenever a white shellac dries milky, it is best to send it back to the manufacturer or,

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if that is impossible, thin it down with high grade alcohol and use two coats. If the shellac dries slowly and remains tacky, it is sure to be adulterated. And, remember this: That where a shellac dries slowly, you can anticipate that the varnish coats will act likewise.

HOW TO TELL ADULTERATED SHELLAC.

The chemicals and method employed for bleaching shellac when not properly removed, are apt to cause the difficulties so common to white shellac. It has been variously attributed to the presence of adulterants, but really in white shellac, more often it is due to the imperfect removal of the chemicals employed in the bleaching process. The presence of chloride of lime, water and sometimes oxalic acid, is probably that which gives the milky results, and it is almost impossible to correct a shellac which has gone wrong owing to the presence of any one of these agents employed. It is more necessary to carefully store white shellac, owing to the fact that it has a greater affinity for water which is due to the process it has been subjected to in the bleaching.

We have been given suggestions that are well to mention: Always use a glue set brush for applying shellac varnish. Use thin shellac. Two coats of thin shellac are better than one heavy coat. Steel wool is better than sandpaper for smoothing the surface between coats. Do not touch up missed places. They must be avoided. Keep the surface smooth.

WHEN SHELLAC WORKS HEAVY.

If a shellac works heavy, the addition of Venice turpentine of about 10 per cent to the amount of gum used, will make it work much better. Shellac should never be kept in tin or metal containers. They are apt to turn it black. If it does turn black, a little oxalic acid will restore the color. Where large surfaces have turned milky, an electric flatiron will often restore the color. This is due to the fact that it melts the fine particles that have congealed. Placing the work near a steam pipe will also restore the color. The electric flatiron can be applied over a piece of tracing cloth so that it will not stick to the surface. It must not be moved around, but merely held in one place until enough heat is absorbed in the coating to melt the particles which are showing white.

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Under the name of Texico spirits, the Texas Company, which has offices in all of the larger cities, is marketing their product, the solvent powders of which are comparative with turpentine and which is recommended in the place of turpentine. The following tests are given:

Gravity .....50 degrees B.
Flash .....100 degrees F.
Boiling point .....276 degrees
Evaporation .....18 minutes
Solvent power comparative with turpentine.

FORMULA FOR GOLD PAINT.

Formulas for gold paint are legion and every manufacturer has his own secret composition, says an exchange. Essentially, gold paint is bronze powder mixed with a varnish, or other medium, and it is to the discovery of a perfect medium that attempts are being directed. Suffice it to say, that perfection has not come yet, and that the finest gold paint is markedly inferior, both as regards appearance and durability, to the gold leaf gilding which it is supposed to imitate. The best bronze powder for making gold paint has the trade name of French flake. This is a deep gold color and, as seen through the microscope, consists of tiny flakes or spangles of metal, each flake forming a facet which reflects light. For this reason, gold paint made with it is more brilliant than that prepared from very fine bronze powders. These preparations known as "washable gold paints," have celluloid varnish as a medium. To make this varnish, prepare a saturated solution in acetone of one ounce of finely shredded transparent celluloid and make up to 20 ounces with amyl acetate. The quantity of flake bronze required will vary from one ounce to four ounces. Washable aluminum paint is prepared by substituting the flake bronze powder of that metal for the gold bronze. The superiority of the celluloid varnish as a medium lies in the fact that it incloses the metallic particles in a coating that is impervious to air and water, and that it contains nothing that will act on the bronze. Celluloid varnish certainly appears to be the best gold paint medium yet discovered.

ALUMINUM PAINT.

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VARNISH FOR METALLIC SURFACES.

Asphaltum varnish has been the accepted material for the painting of metallic surfaces. A German scientific journal gives a new suggestion which may be of interest to the factory owner. It recommends the use of red lead with raw linseed oil, and gives as a reason that steam pipes, owing to their often exposed positions, should be painted red so as to denote danger. Heretofore, red lead has been employed by the plumber to put into the joints of pipe lines and mostly because when mixed with linseed oil it will harden and form a cement. This, it has been found, is not due to the red lead, but rather to the yellow lead, which was largely present in the red lead as then manufactured. Present day red lead is now sold so pure that it works up into a good paint. It will dry hard and has with it all the qualities that the extreme oxidation can give it. Be it understood that there are three oxides of lead, viz: Plumbago, or black oxide; litharge, or yellow oxide; red lead, or red oxide. Each contains a molecule more of oxygen than the other. An ideal paint can now be made by using 33 pounds of red lead to seven and three-quarters pounds of linseed oil, which is equivalent to one gallon to one-third of a hundred of red lead. The pigment is first rubbed up with a very little oil, made into a thorough paste and then the balance of the oil added, when it will form a first-class paint, perhaps a trifle stouter than the ordinary white lead paint, but there is no difficulty in brushing it out nor in spreading it. The paint will flow well, soon obliterating brush marks after crossing it. In this present age, where we find that it pays to do things well, and once for all, the suggestion of our German scientist may be well to remember.

REMOVING ROSIN IN KNOTS.

The disfigurement of a factory show room which has been painted white or kalsomined, by the rosin in the knots of the timber, ceiling, or partition, coming through can be avoided by a novel treatment which has been suggested and has been tried out. A blow torch is used to heat the knot as hot as it will stand without burning. The heat draws the rosin out and the knot is then washed with turpentine and linseed oil. With this treatment no shellac is needed. Up to this writing,

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the shellacing of knots has been the accepted method for holding back the rosin. However, it never was a positive preventive and experiments as here suggested have shown that this new method is absolutely reliable. It is especially recommended in factory buildings where the timbers are coated with the fire-proof paint. The process eliminates all of the rosin to the depth of over an eighth of an inch, and the heat so contracts the pores of the knot that it forms in itself an impervious surface.

OVERCOMING WHITE OR GRAY SHELLAC FINISH.

It is necessary that the finisher become familiar with a method for overcoming a shellac finish which either turns white or gray due to atmospheric conditions or otherwise.

Whenever a piece of furniture is troubled in this way, procure grain alcohol and a camel hair brush. Brush the work with this alcohol. You might say coat it, but do not brush back and forth. Just draw the brush over the work so that the shellac finish is moistened. The idea is to redissolve the congealed particles and have them take on a clear crystalline condition. This operation may have to be rubbed. Let it stand over night and rub with very light pumice stone, soft felt and rubbing oil. The only caution necessary is not to rub up the finish, which the novice is apt to do.

The use of stock shellac is the most modern method for repairing blemishes, filling cracks or other injuries to the wood. It comes in one-half inch square sticks of some 30 odd shades, being colored to match every kind of finish. The ideal way to apply it is by means of an electric soldering iron, which can be connected with ordinary light socket. When the iron becomes hot it will melt the shellac, the operation being the same as that of the tinsmith when he applies his solder. If this tool is not at hand, a little alcohol flame is good. A candle may do, but there is danger of the candle wax dropping off. After the injury or crack is filled with this colored shellac sand carefully to even the surface and proceed in the usual manner with the finish.

REPAIRING BLEMISHES WITH SHELLAC.

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CHAPTER LVI.

THINGS WORTH KNOWING ABOUT LINSEED OIL.

LINSEED oil is a drying oil; that is, an oil which will absorb oxygen from the atmosphere, and during this absorption become solidified into a rubber-like, water-proof film. The absorption of this oxygen produces a gain in the weight of the oil.

SOURCE OF LINSEED OIL.

Linseed oil is pressed from the flaxseed. The flax, in this case, is grown especially for crushing purposes.

To make the best oil, the flax is not cut until its seeds have commenced to ripen. This is the practice in India where labor costs only a few pennies a day. Here the flax is pulled and manipulated entirely by hand and the seed is very plump and rich in oil, because the juices have been enriched by the natural process of ripening. The India seed produces an oil which is highly prized by all those who must have linseed oil, second to none; especially varnish makers, who consume enormous quantities. This method of harvesting flaxseed cannot be practiced in this country nor in South America or Russia, where great quantities are produced, as it would raise the price far beyond reason.

In America, flax is cut by machinery, exactly as is wheat. Now, if the farmer waited until the seed had started to ripen, much of it would shell out from the shaking of the harvesting machine and would be wasted. To prevent this, the seed is cut while in the "dough," as it is called, just previous to ripening. Although it becomes solid and ripens after cutting, it does not receive the juices which would have been obtained if left to ripen naturally. Indeed, much of it is cut so green that it produces a very inferior oil.

GREEN FLAX PRODUCES INFERIOR OIL.

Much is heard about cold-pressed oil, but with the powerful hydraulic presses (the most common means of extracting the oil) it matters little whether the flax has been heated slightly (is hot pressed) or not, as to the resulting quality. Heated seed, however, will make a more highly colored oil, due to disintegration of muci-

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laginous matter. It is doubtful whether this injures the binding qualities of the oil, as claimed by some, as much of this matter settles upon standing.

In varnish manufacture particularly, refined oil is necessary. Linseed oil contains some coloring matter which still remains after the oil has settled. Ordinary oil will impart a yellowish tint to certain light tones especially to white pigments, particularly white lead and zinc white. This refining is usually done by agitating it together with sulphuric acid or alkali and filtering.

REFINING THE OIL.

Boiled linseed oil is the name usually given to oil which has been heated to a temperature of at least 250 degrees Fahrenheit, with or without the addition of drier. Boiled oil is not as elastic as raw oil and is little used for exterior work. For interior work, however, much is used as conditions are less severe. Then, too, the boiling causes the oil to dry much quicker, which is particularly desirable for interior work.

The possibilities of obtaining pure boiled linseed oil are very slight and much of it sold under this name is really raw oil, to which a cheap benzine drier is added. This gives the oil the proper color and drying qualities of boiled oil. This adulteration, however, is detrimental to the durability of the oil.

The most frequent adulterants are mineral oil, rosin oil and fish oil. If heavy mineral oil is used, the oil will dry extremely slow on glass and after a few days a greasy surface will be noticed on the oil film. If a lighter mineral oil is present, the oil will dry perfectly, but the adulterant may be detected by the use of a hydrometer, *i. e.*, by determining its specific gravity. The specific gravity of pure raw linseed oil should be between 0.932-0.936, while a refined oil may often be 0.001 lower, and a boiled oil may be considerably lighter. Hence, inasmuch, as the specific gravity of light mineral oil often runs as low as 0.725, a specific gravity of less than 0.931 would probably indicate the presence of this adulterant.

ADULTERANTS OF LINSEED OIL.

The detection of rosin oil and fish oil is much more difficult. Rosin oil may possibly be detected, if considerable is present, by rubbing a little between the palms

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of the hands and noting the odor, also by noting the rate of drying and the appearance of the oil on glass. Raw linseed oil should dry in from three to four days, while rosin oil causes the film to remain tacky for a long time and prevents it from hardening.

Fish oil is very hard to identify if thoroughly deodorized and present in small quantities. However, if considerable is present, upon heating, the odor may be revealed, but the greatest care must be exercised not to confound the odor with that given off by certain raw linseed oils when heated. A careful regard for the drying and appearance on glass will be helpful, for when fish oil is present the film will remain tacky indefinitely.

FISH OIL FREQUENTLY USED.

Often if a heavy mineral oil or rosin oil is used, the oil will have a "bloom" or bluish cast, which may be emphasized by pouring the oil upon a black surface.

Semi-drying oils, such as soya bean oil and corn oil are seldom used to adulterate on account of their own comparatively high cost.

When there is any doubt at all about the delivery being pure, the best course is to forward a sample of it by express to one of the large crushers who maintain laboratories and a force of experts in this line. They are always very glad to test samples for the trade and make reports at a very moderate rate, or in some cases without charge.

To darken wood with linseed oil, have the surface perfectly clean, free from finger stains and other discolorations, then apply the oil, giving as even a coat as possible.

DARKENING WOOD WITH LINSEED OIL.

Do not try to rub in the coat of oil. Go quickly and evenly over the surface of the wood, giving all attention to applying an even coat, and avoid all lapping of strokes as much as possible. The wider a brush that can be used, the better the job, but wide brushes require lots of muscle to drive them when applying linseed oil, especially when it is used as a first coat.

The use of fillers is not very desirable when this process of darkening is to be used. At least I have not had good results when a filler was used before the linseed oil was applied, so it has become my custom to

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darken the wood first and then afterwards rub in the filler very sparingly.

Sometimes it may be desirable to use two or even three coats of linseed oil, depending upon the kind of wood and degree of darkening required. It is best to make up small sample pieces of each kind of wood to be handled, giving one, two, and three coats of linseed oil to as many samples of each kind of wood, then you will be in position to know exactly how many coats of oil will best suit the work in hand.

FILLER NOT DESIRABLE WHEN THUS DARKENING.

After the oil has been applied, and has dried, or "struck in" sufficiently to allow the work to be handled without showing finger spots, place the work in a japanning oven and bake at least two hours at a low heat, then raise the temperature until, at the end of the third hour, the wood gives off a smell of scorching—the "hot-wood" smell with which we are all so familiar.

Upon removal from the japan oven, after treatment as above, the wood will be found very dark, closely resembling ebony, somewhat rough on the surface but easily smoothed by light sandpapering or by burnishing with a blunt steel tool. Care should be taken in sandpapering to remove as little as possible from the surface, for the darkest fibers are those closest to the surface, and the more they are removed the lighter and more streaked the work will appear.

"BRINGING UP" SURFACE BY SANDPAPERING.

Very light sandpapering, indeed, will "bring up" the surface. It seems that the work requires more of a polishing, if that term can be allowed, with old or very fine sandpaper than a regular sandpapering. Just remove the fibers raised by action of the oil and the heat. Oil swells wood in the same manner that water swells it, although to a far less extent, and the surface fibers are sure to be slightly raised by the oiling process. Take off these raised fiber-points and a smooth surface is again obtained.

Whatever filler is to be used should be applied before the sandpapering is done. Sometimes it is possible to sandpaper before the filler is thoroughly dry—not appreciably wet, but just green enough so the dust raised by the sandpaper will be caught in the damp filler and retained in the cavities of the wood. Some

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excellent effects may sometimes be obtained in that way, but great care is required, or the work may be spoiled by a muddy, streaky look, which no subsequent operation can remove, short of planing the entire surface and darkening it again.

AVOIDING MUDDY LOOK.

When the surface has been darkened and smoothed to suit, it can be finished either by varnishing, or by oiling without any varnish. Or, a certain proportion of varnish may be mixed with the oil and excellent results obtained. The use of oil alone gives that peculiar effect so much desired by the makers of Mission styles.

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CHAPTER LVII.

AIR BRUSH EQUIPMENT IN FINISHING.

MUCH has been written about the methods of air brush finishing, but the information, while giving essential points, has not seemed technical enough on the actual merits of the equipment. The finishing of a manufactured article is of vital importance from the standpoint of sales. Nothing depends more on increasing the reputation of the manufacturer than the care given in finishing his product. Appearance counts for considerable from the point of view of sales, reputation and satisfaction.

SALES DEPEND ON FINISH.

The air brush, while necessarily a mechanical tool, should be of such construction that it will be capable of supplying the manufacturers with these qualifications of finish demanded of it. It must be a tool not only equal to the improving of finish at a big saving, but one which will add to the product such refinement in the work that it immediately becomes a very important factor in the shop. It must not be merely a sprayer. It should be an instrument of great efficiency; one which responds to the slightest will of the operator and is under his absolute control at all times. There is a big difference between an air brush and a sprayer. The air brush represents the most complete or advanced stage of finishing devices. The same relative difference is proven daily in air brushes in regard to quality and efficiency, as any finisher knows who has used good and poor air brushes. Air brushes will absolutely apply finishes more evenly, more economically and satisfactorily than the old method of hand brushing. Economy in finishing does not rest with the saving of time. It is an assured fact air brushes will save the manufacturers from 25 per cent to 75 per cent in labor as well, depending on the nature of the work to be finished. Compressed air costs little compared to the great saving in time and labor. Manufacturers, owing to the ease and speed of handling the finishing of their products,

AIR BRUSH DOES BEST WORK.

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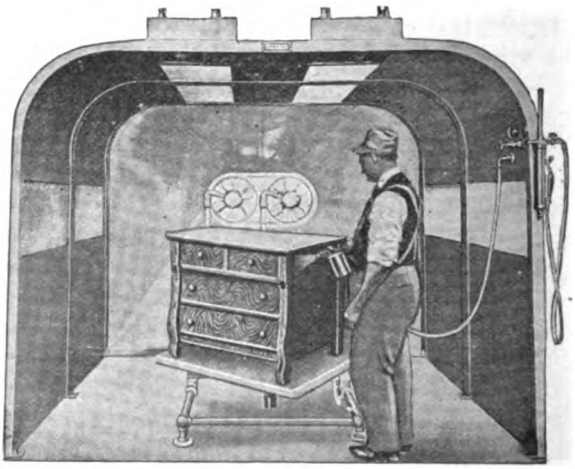
have been able to double their output without adding to floor space or increasing payroll.

AIR BRUSH ECONOMICAL.

Many manufacturers have been amazed at the seemingly large waste of material. Some have been misled by ones not specific enough. Air brush finishing actually wastes very little material, due to the fact that the material, as applied with the air brush is, or should be, thinned five to 50 per cent, according to the nature of the work and various materials used. There are innumerable preparations of all kinds and descriptions used. These must be reduced in regard to consistency. The thinner seldom is costly. While there is a waste, this volume in waste depends wholly with the equipment in use as well as the experience of the operator.



THE AERON SYSTEM OF FINISHING

Considering the superior finishes obtained and the great saving in other features, the small waste is not considered by manufacturers who have become thoroughly posted and experts in the proper manipulation, and perfected their system of handling the work. Manufacturers who have used and observed the finishes produced by air brushes all agree on one point, namely: That air brush finishing when completed is far superior to hand brush methods. Uniformity of finish without

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tears, sags, runs or dregs along the edges is a feature of air brush finishing. The finishing material being applied by air is forced into every crevice by the simple sweep of the hand and the pull of a trigger removing the strenuous efforts on the operator which would tire him out should this same force be induced in hand brushing. On uneven surfaces, carvings, ornaments, etc., air brush finishing is particularly advantageous. A great many plants have a foreman of finishing who may be an expert, particularly in flowing on a finish. Should he become sick or die, it often ties up the whole finishing department until another efficient or expert foreman is found to fill this vacancy. When air brush equipment is installed after a very short time, depending with the finisher handling the air brushes, the operators are all experts. This is of untold advantage to the manufacturer. Most materials will set twice as quick when applied by the brush, particularly in case of shellacs, enamels and varnish.

MATERIALS SET QUICKER WITH AIR BRUSH.

Manufacturers should be sure to help the finishers to obtain the best results by co-operating in installing proper equipment. The oil and water separators should be installed near the finishing booths. This removes all moisture and grease or dirty oil which may work into the air lines from air compressor and endanger the finish or ruin it.

Better finishes are obtained by heating all materials as well as the air with proper heating system. This is essential in spraying varnishes and shellacs. Too much cannot be said of its value as used in connection with air brush finishing. In reality it is one of the many important parts of a high grade finishing equipment. The absence of a good heating system has caused many a manufacturer no end of trouble and great losses at various times. The virtue of heating, not only the material but air as well, was not known and appreciated until a short time ago. Since the fact became known, the result has been better finishes and thousands of dollars have been saved.

FINISHES SHOULD BE HEATED.

Fusel oil when used sparingly, particularly in spraying of enamels and heavy paints, is found very satisfactory in air brush coating. The under coating can

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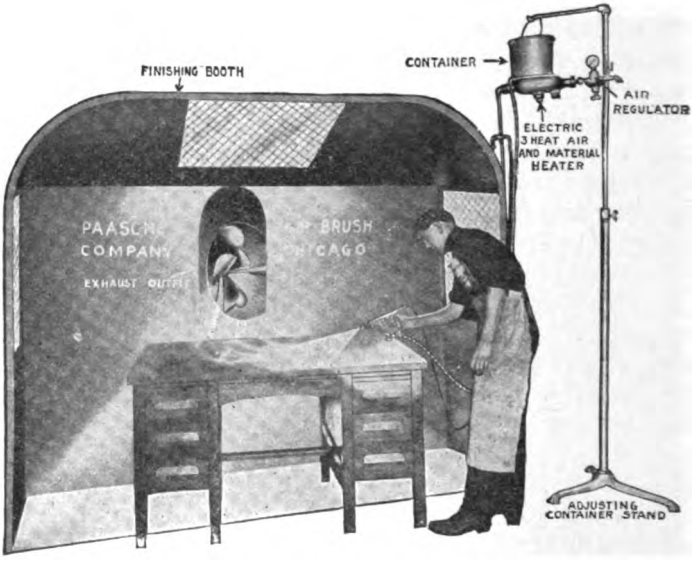
be done with ease with much better results than can be obtained by the harder method of air brush work. The air brush ordinarily saves two coats out of five required by hand brush methods and very frequently gives the same or better results in two or three coats that manufacturers have been giving the same product, using five or six coats by hand process work.

TWO WELL KNOWN AIR BRUSH METHODS.

Air brush finishing does not rest with the manufacturers of high grade furniture or wood products but



RAPID METHOD OF APPLYING VARNISH

is also being used with remarkable success by manufacturers of metal goods who have found a bigger saving with the same special advantages as furniture, piano manufacturers for filling, coating, enameling, lacquering, bronzing and all around finishing.

TWO STYLES OF AERONS.

There are two equipments for finishing along the lines just indicated: The Paasche or air brush method described in the foregoing paragraphs, and the Aeron, or the spraying method.

There are two styles of Aerons, one with the attached fluid cup, and the other without the cup, receiving the fluid from a container placed overhead. Of these

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two styles there are several sizes and different types to meet every requirement. Then there is the air compressor and the air receiver, and also the air transformer set, together with air duster, for regulating the air pressure and purifying the air, and for cleaning the parts to be finished.

There is also the electric air heater which is attached to the Aeron at the last possible point of contact, and which supplies the only practical way of heating the air and keeping it heated until it reaches the work, and of raising the temperature of the material.

SPRAYING DONE IN A FUMEXER.

To complete the equipment there is the fireproof, indestructible steel fumexer in which the aeroning or spraying is done. The back of the fumexer is funnel-shaped clear to the floor. This scientifically correct style of back together with the large fan opening and arrangement and the short exhaust pipe combine to insure the height of exhausting efficiency. The fumexer is made in a variety of sizes, ranging from three feet to 16 feet in width, with the proper number of fans installed in each size. A turn-table, which is also supplied, greatly facilitates the handling of the work. The autocool electric exhaust fan installed in the fumexer has a protected and automatically cooled motor; it can be swung inward for cleaning; each fan is a self-contained unit and can be adapted to any kind of work; it requires no belts, nor millwright work, and takes up no valuable floor space; it has a one-twelfth horsepower motor and can be attached to any electric light socket, using one-tenth to one-twentieth the current to do the same work as other style fans. The autocool fan is made in one size only, the number of fan units being increased to two or more for fumexers above five feet in width. The big advantage of the fan arrangement is that a better distribution of exhaust is secured, and the vapor is quickly moved at low pressure.

ALL PARTS CAN BE COATED IN ONE OPERATION.

In using the Aeron system, for which the air pressure required varies from 30 to 80 pounds, it is not necessary to finish separately different parts of any particular job, allowing time for one part to set up before coating another, in order to obtain a full bodied application. All surfaces that are to be finished can

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HEAVIER COAT THAN WITH BRUSH.

be coated in one operation, and it is also quite possible to put on a heavier coat than with the brush without the danger of sags or runs. This is of particular advantage in the application of coach varnish, where a full body and high gloss must be obtained with as few coats as possible.

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CHAPTER LVIII.

EXPLAINING A STANDARD.

IN AN explanation of the following term, "U. S. P.", let it be said that these letters stand for the words United States Pharmacopoeia. This work is a standard, adopted by the United States government which has a commission that meets every 10 years, and standardizes medical and chemical compounds as well as chemicals themselves. Thus when a formula is given in New York City and filled in San Francisco, it will be made up of the same standardized material. Not only is this true of our country, but the foreign countries, in fact almost all the countries comprising the Postal Union, have adopted the same standard.

MEANING OF U. S. P.

It has been mentioned in this book that materials of universal standard and materials subject to as little physical change as possible should be employed. For example, the reference to the solution chloride of iron, or the solution sulphate of iron. This material, as well as many others, is governed by the U. S. P., and therefore, the purchasing of materials under this standard will obviate a great many pitfalls in the making of stains, according to the formulas given.

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CHAPTER LIX.

THE PRODUCTION OF LACQUERS.

LACQUERS are coming more and more into use in the finish of high grade furniture, and it is evident the demand will increase rather than decrease in the years to come.

HIGH SKILL AND CARE NEEDED.

The preparation of their solvents calls for high skill and care. Lacquer solvents are prepared water white and free from both water and acid. Those solvents that are free from acid when made and become acid with age, must be avoided, as their presence spells trouble. They produce discoloration of the metal. Long experience alone tells what solvents to use together and in what proportions. A single solvent cannot be used, for dip work requires one rate of evaporation, while spray work requires another.

The base solvent of lacquer is nitrated cotton, made by soaking clean cotton in mixtures of nitric and sulphuric acids at various temperatures and lengths of time. As cotton fiber is hollow and very absorbent, it is a difficult and lengthy job to wash thousands of pounds of it after nitration, making it free from acid. If acid is left in the cotton, the latter will decompose, and if the cotton is made up into lacquer before that operation, the lacquer will naturally be defective.

GUMS ADDED FOR GLOSS AND HARDNESS.

In the production of heavy-coated, high gloss lacquers, various gums are added, some to cause hardness, some for gloss and some for adhesion, each in proper proportion, and each with the necessary amount of the proper solvent. If the use of heavy coats of gum lacquers are used, they should be dried under considerable heat to produce the right hardness. The gloss will then be greater.

Green and brown stains on brass and bronze wares cause frequent troubles. They are usually caused by acid conditions of the lacquer, brought about in many ways, usually by unclean work. Lacquer work must be chemically clean. Metal in the lacquer will corrode.

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Lacquer thinner is a good cleaner and removes quickly any buffing dirt and leaves it in the lacquer. Brass work that has much soft soldering and is acid dipped will cause trouble. For that and all similar troubles, use the lacquer in as small dip tanks as possible, and at the end of a day pour back the lacquer unused, after filtering through cheese cloth.

WRONG CONTAINERS FOR LACQUER.

For silver work only glass tanks and stone jars should be used as containers, except for common work when tin cans soldered with tin may be used. Lacquer should not be kept in lead, copper or zinc cans. Poor work with lacquer, which is often charged up to poor material, is usually traced to keeping it in an improper container.

In medium priced work there is often trouble with the lacquer turning white in drying. With fusel oil now so high priced, it is evident lacquer cannot be made at a cost less than the price of the oil unless a lower priced solvent is used with the amyl acetate. Lower priced solvents are rapid-evaporating. The turning white trouble takes place only in very damp weather, when it is so warm that windows of the work room are thrown open. The work is chilled which causes the lacquer to turn white. It will not take place if the work is done in a dry atmosphere.

"Pink silver" is caused in various ways. Grease left from buffing will produce it; if the work in hand has not been thoroughly cleaned of red buffing material, the work is sure to be pink after lacquering. Some hollow ware with a fair plate on the outside, but no special attention paid to the inside, will often show all right on the former and a rich pink color on the latter, some time after lacquering.

QUALITIES OF LACQUER ARE MANY.

There is a great variety of work in lacquer in China and Japan, with almost as many qualities as there are varieties. China and Japan both claim priority in the art of lacquering. Japan has brought the art to its highest development in every way, although some samples of Foochow lacquer equals that of Japan for commercial shipments.

The exact process of preparing lacquer not only differs as between China and Japan, but differs in the

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nature of each piece of work, the article made, the color and quality. In general, the basis of all lacquering is a varnish obtained from the resinous juice of the *rhus vernicifora* or "uruso-no-ki," "urushi" or "varnish tree" cultivated in many parts of China and Japan for the purpose. This tree, in many respects, resembles an ash. It grows to a height of from 15 to 18 feet, and can be tapped after seven years. The varnish is obtained by making incisions in the bark of the tree, near its base, before daylight during the months of July and August and catching the sap which exudes as a mixed clear and milky product.

THE BASIS OF LACQUER.

This sap is placed in tubs or similar vessels which are set in the sun to exaporate all moisture. It separates into a clear, almost colorless resinous liquid which rises to the top and into a thicker, more resinous and darker liquid mass which settles to the bottom. The qualities are then separated by decanting, the top representing the finer grades and the bottom the lowest grades used for ordinary paints, "Ningpo varnish" and similar ordinary work. This liquid, in its various qualities, is the basis of all lacquering, and variations in treatment begin with the various ways and degrees of refining of the liquid. The liquid is separated into grades by minute degrees for fine work.

It is colored various shades in various ways. For example, in China, black is obtained by stirring the liquid in the air until it thickens somewhat, and then mixing with it a stain obtained by mixing gall-nuts and iron. Other shades involve the use of ox blood, sulphate of iron, vermilion, tea oil and other substances. In China the liquid is thinned for use by the addition of vernicia montana, Camellia cleifera, sulphate of iron, rice and vinegar and sometimes wood oil. The use of each of these substances represents some especial need, difference in quality or condition or especial object in view, and is not altogether a matter of convenience at the time. The lacquer is poisonous until dry.

THE COLORING OF LACQUER.

Usually the wood to be lacquered is soft, dry pine. The surface and corners are made absolutely smooth; joints are stopped by oakum, paper pulp or strips of

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grass cloth. Paper is pasted over rough joints to make all smooth for the varnish. Emery powder is then used for a coat on the piece, sometimes vermilion or gamboge being used. After drying, the whole is ground down by pumice stone, powdered sandstone or powdered deer horn. The same preparation is again applied and ground down again. Then the lacquer is evenly applied with a broad, soft brush and in a room free from breezes and dust, and with a minimum of light. In fact a dark, damp room is the best lacquer finishing room. After the varnish dries, the piece is ground down and polished. The same process is then repeated, the minimum number of coats being three, while often as many as 16 are applied.

THE PROCESS OF LACQUERING.

For solid colors, this alternate varnishing and polishing constitutes the finish. Various decorations are applied in different ways. In mother of pearl inlay work, for example, the mother of pearl is cut in the desired figures in thin shell, and the pieces are placed in position on the undried surface soon after the application of one of the early coats of varnish and are then varnished over, polished as the rest of the surface, revarnished, and so on, becoming imbedded in the enamel and polished and repolished as a part of it. Lacquer is mixed with various substances, and raised figures are made and applied to the surface in the same way and are ground and revarnished in the same way for relief work. The process is the same, with varied manner of work, for articles of the most intricate design. In general, the difference in qualities of lacquer work, therefore, depends first, upon the high refinement of the lacquer and the manner of its early treatment, which in the old processes often represented the work of many men for an incredible time, most of which finer processes are impossible in countries without labor of extraordinary cheapness and skill; and secondly, on the care and skill with which the articles lacquered are prepared, and the care and skill with which the lacquer is applied and decorations are made.

DIFFERENCE IN QUALITY OF LACQUERS.

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CHAPTER LX.

GOVERNMENT PROTECTION TO MANUFACTURER.

IT IS NOT generally known that turpentine, which is used in every finishing room, and in so many different ways in the manufacturing industries, has a governmental standard, according to an act regulating the sale of turpentine and providing penalties for the violation of this act. Turpentine is designated Pure Gum Spirits of Turpentine, and every dealer or manufacturer selling this article must so brand it. All that is necessary is to demand spirits of turpentine, as designated by the government, and it is then up to the manufacturer or wholesaler to deliver the article.

ATTEMPTS TO PREVENT ADULTERATION.

Provisions are made in the act for the marking or labeling of compounds which distinctly prescribes that it shall be labeled "Adulterated Turpentine." Turpentine made from wood by the distillation of pine stumps, etc., must be labeled Wood Turpentine. A good deal of adulterated turpentine is still for sale, and is offered where price competition is strong because it is so easily adulterated with naphtha. The act regulating the sale of the genuine article is not generally known by the consumer. As soon as the buyer understands what he can rightfully demand, all that is necessary, for him to do, is to ask the salesman to deliver to him spirits of turpentine according to the act, which is very plain.

The act as given is that of the State of Michigan, and in all points it is practically the same as that of other states governing the sale of turpentine.

We give herewith a copy of the house enrolled act regulating the sale of turpentine and providing penalties for the violation of the act:

Section 1. No person, firm or corporation shall manufacture, mix for sale, sell or offer for sale, for other than medicinal purposes under the name of turpentine or under the name composed of a part or parts of the word turpentine, or spirits of turpentine, and any ar-

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ticle which is not wholly distilled from resin, turpentine gum, or scrape from pine trees and unmixed and unadulterated with oil, benzine or other foreign substances of any kind whatsoever, unless the package containing the same shall be stenciled or marked with letters not less than one inch square and one-fourth inch apart, "Adulterated Turpentine," except turpentine produced from turpentine gum, extracted wholly from pine wood which turpentine is known as "wood turpentine," must be stenciled or marked "wood turpentine" with letters not less than one inch square and one-fourth inch apart. When such wood turpentine is mixed and adulterated with oil, benzine or other foreign substances of any kind whatsoever, the container shall be stenciled or marked "Adulterated Wood Turpentine" with letters not less than one inch square and one-fourth inch apart. When wood turpentine is mixed with turpentine distilled from resin, turpentine gum, or scraped from pine trees in any quantity whatsoever, the container shall be stenciled or marked "wood turpentine" with letters not less one inch square and one-fourth inch apart. Nothing herein contained shall be construed to prohibit the manufacture or sale of any compound or imitation, providing the container shall be plainly marked and the purchaser notified as aforesaid.

TURPENTINE HAS MANY SUBSTITUTES.

Section 2. The dairy and food commissioner of Michigan shall enforce the provisions of this chapter and the penal statute relating thereto, and such commissioner, his assistants, experts, chemists and agents shall have access and ingress to the places of business, stores and buildings used for the sale of turpentine, and may open any package, can or jar or other receptacles containing any turpentine that may be manufactured, sold or offered for sale in violation of this statute. The inspectors, assistants or chemists appointed by such commissioner shall perform like duties and have like authority under this chapter and the penal statutes relating thereto as is provided by law. Such commissioner shall publish bulletins from time to time giving the results of the inspection and analysis with such information as he deems suitable.

STATE AUTHORITIES PROSECUTE.

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Section 3. Whosoever violates any provisions of law relating to the labeling, marking or stenciling of turpentine or wood turpentine by manufacturers or distributors thereof, shall be fined not more than $50 for the first offense, and for each subsequent offense shall be fined not less than $50 nor more than $100, or imprisoned not less than 30 days, nor more than 100 days or both.

PENALTY FOR OFFENDING.

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CHAPTER LXI.

THE CARE OF RAW FINISHED STOCK.

WITH the furniture factory, planing mill, or anywhere that the finished stock is of a grade that is finished natural and not painted; where freshness and the tone of the wood is an object, it is almost as important to take proper care of raw finished stock after it has been through the machine as it is to exercise care in doing the work right with the machine.

STORING FINISHED STOCK.

Anybody knows, or ought to know, that it is not good for clean, bright, finished stock to be handled with soiled hands. In sash and door houses where they exercise great care in keeping the stock fresh, because it must be kept stored a long time, they often make the men handling it wear clean duck gloves or something of the kind, to prevent soiling it with the hands.

Then in storing it they take pains to keep not only the sunlight but the daylight away from the stock. They keep it in dark warehouses where it will remain as fresh as if it had just come from the machine.

Stock in the furniture factory is not often carried such a length of time before being finished because it is realized that the sooner the finisher follows after the jointer the better. Often, however, it is necessary to keep the stock stored some time before it is put up and finished. For this purpose provision should be made to protect the stock not only from dirt and dust, but from sunlight and, in so far as it is practical, from daylight.

STORAGE ROOM OUGHT TO BE DARK.

You should have dark storage rooms that are clean, and preferably dust-proof; especially should you have these for left-over stock that may come in useful on a future order. It is the one sure way to keep it fresh, and to get real satisfaction out of the work.

Above all, sunlight should be avoided. A truck load of finished stock should not be allowed to stand where the sun shines on it brightly. The sun is one of the greatest bleaching agents and will take the life and

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tone out of wood quicker than almost anything else except the splashing and dripping of water on it, a thing which is not allowed in any well regulated institution.

FINISHING ROOM A PLACE OF CONCERN.

The finishing room of an up-to-date factory is no longer a place of filler and varnish, but in reality has become a place of concern. The numerous new styles of furniture carried with the different colors peculiar to each historical period, and latterly the scarcity of native woods, the introduction of foreign woods, and the using of cheaper woods, together with some woods heretofore considered unworthy of use, have put upon the finishing department a problem for every day.

The individuality of colors, or shades, adopted by manufacturers, those who are leaders in styles and fashion and are considered originators, who thus have the prerogative of establishing colors, which must be followed by others, places upon the finishing room the responsibility of matching these colors and styles of finish. All this has become such an art that the foreman of every factory must be not only a foreman, but, at the same time, a color artist. His office nowadays represents a small laboratory.

There are many other problems which confront the finishing department. The preparation of the work, the mixing of the fillers, quality, color, and shade, shellacs, first coaters, varnishers, waxes, etc., all call for attention. In all of these the foreman finisher has to consider the color, quality and uniformity. While everyone has his own way of judging the quality, there are certain methods and tests which may be used which we hope to present in a simple manner so that they can be adopted and employed by the man who wants to know.

LAX METHODS ENCOUNTERED.

The first difficulty encountered by the finishing department are often the lax methods of the joining room. Although this department, in recent years, has received more attention than any other, it is still in need of radical correction. The chief fault is the inattention in matching. For instance, it is not uncommon to see a nice table top with the wood laid one piece up tree and the other down, thus imposing on the finisher the task

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of getting an even shade with the pores running two ways. Especially is this difficult on filled wood. Had more care been taken in matching the wood, the finished product would have been enhanced in value.

Here the finishing department can work out its own salvation only by the persistent rejection of poorly matched woods. There are certain methods of overcoming these poor matches, but it takes time, and time is money. The up-to-date finisher has bleaches with which he bleaches out a quantity of sap. He has alkalies or acids with which he forces his colors into a harder board or a second growth piece of wood, none of which can overcome or match up to a piece of work which has been properly laid together in a joining room. The higher the grade of furniture made, the less of these difficulties there are to be encountered, so that the man who is turning out a cheap line of furniture has the greater color difficulties. But there are remedies at hand, methods for handling these difficulties, that we hope to offer.

OVERCOMING POORLY MATCHED WORK.

Every finishing department is called upon to deliver different results. One factory may turn out nothing but dull finishes, with but an occasional polished piece. In a piano factory it may be vastly different, but the possibility for any finishing department to get a run of any one particular style of finish remains; the question then is, which method will give the best, quickest, and most permanent results? The question of a good rubbing polish is not the only proposition to encounter. The varnish to be polished is again put up to the finishing department. The varnish that has been employed for years may fall down; the polish may be blamed. It is the intention to publish a few hints that will alleviate these difficulties.

HINTS FOR OVERCOMING DIFFICULTIES.

Years ago colors were produced from vegetable extract matter, some few known chemicals and gases. Science now steps in and hands us any amount of shades or colors which can be applied in three known solvents—water, spirit or oil. The permanency of some of these modern colors exceeds that of others. For the chemist who knows these preparations, it is an easy matter to produce shades by the mixing of the

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primary colors that are permanent. It then depends upon the kind of color employed in compounding, whereas the novice would encounter all kinds of difficulties by going in the open market and attempting the production of colors and shades, with the meager knowledge that at the present time is possessed by the consumer.

NOVICE HAS TROUBLE IN PRODUCING SHADES.

The laboratories of the up-to-date stain manufacturers are continually experimenting with the products as fast as they are produced by the manufacturer of colors. Here they are put through all manner of tests. Not only are these laboratories familiar with these products, so that admixture of colors is done scientifically, but their experiences are invaluable in getting out time-saving and money-saving stain. The man who is continually confronted with new shades, shades of a competitor to match, shades that are just a little different than his own, a certain familiarity with the stain and colors which are offered for his use are requisite.

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CHAPTER LXII.

COST KEEPING IN FINISHING.

AN example for cost keeping which may serve the finisher for a basis of obtaining the exact cost to finish a certain piece, was published in an article by J. W. Withers. It will give the foreman a good idea of how to establish the cost. Take the time of an average workman; the cost of material used can be taken from a day's work and averaged.

COSTS FOR FINISHING.

We will take the brush fumed finish for an example, as about 36 out of 50 will be finished this way. The prices are as follows:

Sponging	$ .04	
Sanding	.16	
Staining	.09	Inside and outside
Sanding	.19	
Shellacing	.08	Inside and outside
Sanding	.15	
Shellacing	.08	Inside and outside
Shading	.18	
Sanding	.11	
Waxing and wiping off	.10	
Total	$1.18	

The method used is to thoroughly dust the article and sponge the surface well with water, allowing it to dry and then sand the grain level with fine sandpaper, using a felt block (as far as possible) to wrap the sandpaper around. Then stain. After drying, it is again sanded. Then shellac with white shellac thinned to one-half its ordinary thickness and sand. Then shellac the second time; then shade with the proper aniline dye dissolved in spirits; apply with a small camel's hair brush and blend with a small cotton pad. This color does for the touching up of any corners that may be sanded "white." After the shading, the final sanding is done. The shading is a particular job, but a good man can work wonders with white sap streaks, and

PROCESS FOR BRUSH FUMING.

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any differences of color soon vanish under his touch, and a fine, uniform tone results.

The reason the shading is not done between the coats of shellac is that we found the last coat of shellac blurred the aniline shading stain, and a muddy look would appear, so we changed, and with good results.

PROCESS IS ECONOMICAL.

It may be said, in connection with this work, that at first we were inclined to think the labor cost more than the material saved and, in some cases, it really did; but as the men grew more expert at it, we saved money. At the price quartered oak is at present, it pays to do it. In any veneered work it does not pay, so the sap edges are always cut off.

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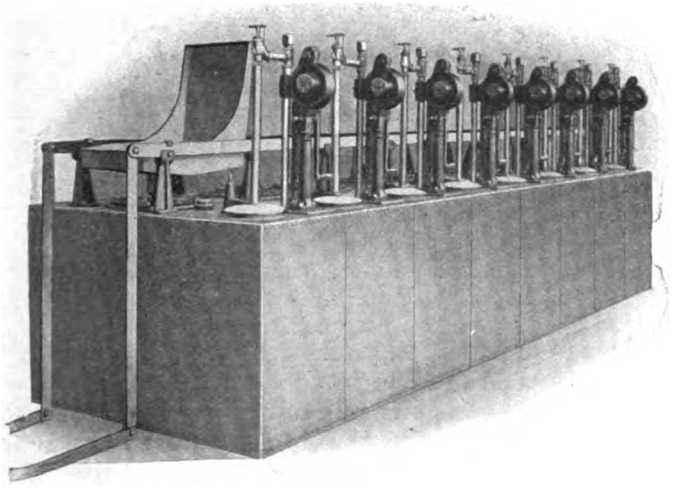
CHAPTER LXIII.

STORAGE OF FINISHING MATERIALS.

STORING and proper distribution of finishing supplies is accomplished by the Wayne and Bowser systems. A familiarity with these systems will at once show the finisher the great advantages and assistance he has in the distribution of the finishing materials to the workmen. All supplies can be piped directly to his office, and drawn from either the oil house or basement, whichever may be the most convenient place for storing of the materials.

TWO FAMILIAR SYSTEMS OF STORING.

Exact record can be kept; first, of the consumption per day; second, of stock on hand, and absolute uniformity of material assured. The expense of the installation is made up by the saving and the reduction of insurance expense.



WAYNE BATTERY OF TANKS

The Wayne and Bowser systems are especially constructed for storing and distributing oils in factories. Heavy steel tanks are leak and evaporation proof and

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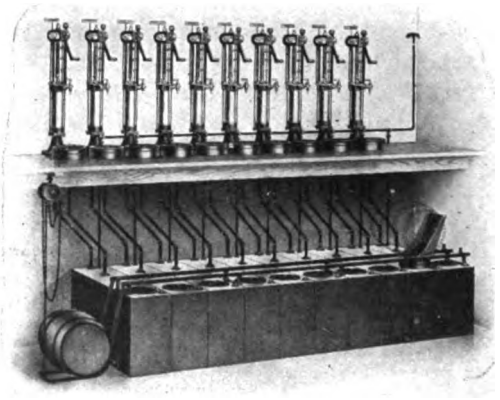
pumps are self measuring. They keep the oils, varnishes, etc., at the original consistency, insuring uniformity, and practically eliminating fire hazard.

SYSTEMS OF BATTERY TANKS.

The Wayne and Bowser systems of battery tanks make an ideal arrangement for storing and handling oils in an oil house. The respective tanks are always of the same length and height, varying in width only to make the desired capacity. When desired, a barrel track can be placed over the tanks with a cradle extending to the floor. The barrel is rolled onto the cradle and raised to the track level with a chain hoist. A



BOWSER "STANDARD" OIL STORAGE OUTFIT

splash pan prevents slop or waste. Where volatiles are to be stored the underground system is used. These battery systems require about 35 per cent less floor space than barrels of the same capacity, and are cheaper and more convenient.

WASTE AND SLOPING PREVENTED.

Tanks may be installed singly. Tanks are labeled with the name of the oil each is to contain, and the pumps lock, making it impossible for anyone to obtain oil without a key. One man can easily handle and empty the barrels. The splash pan prevents waste and sloping. It is placed in position over the proper tank, the bung of the barrel is removed, and the barrel rolled

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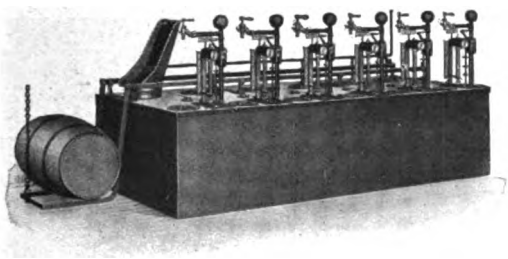
over the pan to the proper position. The pan can be adjusted easily and quickly.

The systems provide for the burying underground, in basements, or in vaults, of tanks from which oils may be pumped throughout the plant with long-distance measuring pumps. This is most economical when conditions will permit it. The tanks may be placed a reasonable distance from the building.

ROLL TOP CABINETS FOR OIL.

In many instances oil is stored in the various departments, as a means of saving time and labor. In the Wayne system roll top cabinets are adapted for that purpose. The cabinet is made of steel and the top closes, making it dustproof. The measuring pump can be adjusted to give the different measures, preventing loss of time and oil, and cutting down the fire hazard. The cabinet is a splendid arrangement for handling turpentine, oil, varnishes, etc., in the finishing department.

The Bowser safe oil storage systems provide the ideal, wasteless way to handle these liquids in any quan-



BOWSER SYSTEM No. 109

tity. The exact amount desired is pumped. There is no over measure, no inaccurate measures to be left lying around to "gum up," collecting dust and dirt, increasing the fire risk and producing nothing but loss. The oils are kept free from evaporation and gumming. The formation of "foots" and "fats" is prevented. The last gallon of liquid can be pumped from the tank in as good a condition as the first one.

The Bowser Cut 109 system is more than a collection of pumps and tanks. It puts the oil room on a sys-

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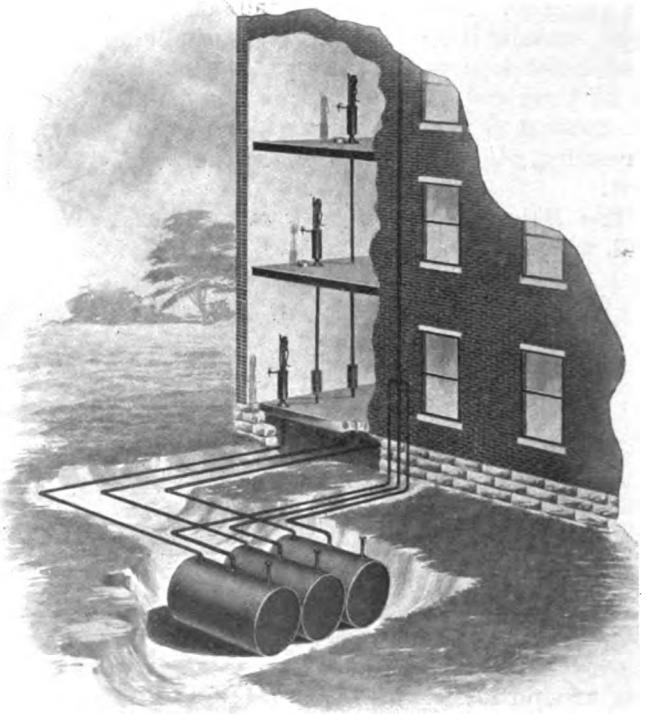
tematic basis. Everything is right where it belongs. The oil room can be kept as neat and clean as any part of the shop or store. There is no increased fire hazard because of the use of Bowser equipment, but on the other hand, the fire risk is greatly reduced over old methods of storage. The equipment presents a neat appearance as the tanks can be set in a row along the side wall where they take up but very little floor space. Each pump is plainly marked so that there will be no mistakes made by drawing the wrong kind of oil. There

OIL ROOM ON SYSTEMATIC BASIS.



WAYNE UNDERGROUND STORAGE SYSTEM

is less likelihood of the oil supply becoming exhausted for the operator can tell in a few minutes just how much liquid is in any particular tank.

The distribution of oil in factory requires consid-

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erable time unless special means are provided. It is a violation of economics to permit skilled labor to waste time going after oil. The portable tank makes this unnecessary. This tank is made of heavy tank steel, mounted on indestructible steel wheels with rubber cushion tires and two rubber-tired guide wheels. It is provided with a self-measuring quart pump. Capacity of tank, 50 gallons. The wheels have steel bearings which make the tank easy to push about the factory. A boy or unskilled laborer can push this tank about the factory and deliver oils to the hands. This keeps the skilled labor at the benches all the time and promotes shop discipline.

DISTRIBUTION OF OIL IN FACTORY.

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CHAPTER LXIV.

SPECIAL HINTS TO ARTISANS.

A METHOD of applying gold leaf, that is claimed to eliminate waste is as follows: Rub a piece of tissue paper on one side with a piece of wax candle or beeswax. Your paper will now have a certain degree of tackiness, enough to cause the leaf to adhere. Now cut this sheet into squares a little larger than the gold leaf. Regular waxed paper, which is used for doing up sandwiches, lunches, etc., could also be used. Then open your book, place the waxed side of the tissue paper on the gold leaf, gently pressing it. On removing, the gold leaf is attached to it, rendering it very easy to use. The tissue paper being transparent, you can see just where you want to place it, or if you desire, you can cut your leaf to suit. By taking the tissue paper in the left hand, placing it with the gold leaf side to the letters, and rubbing the back lightly, with the right hand, the gold will adhere to the size, and you can use the tissue paper over and over again. This is claimed to have the old way of using the tip and cushion beat a mile, and is said to be a much faster way of handling the leaf.

APPLYING GOLD LEAF.

Avoiding "laps" is one of the few hard things for an inexperienced person to learn about painting or finishing. A simple remedy for this trouble is to remember that tables, dressers, sideboards or floors have natural "breaks" or panels which should be finished one at a time. For example, the side of a dresser will be paneled. Take the top panel and paint, enamel or varnish that part of the dresser. Then take the adjoining panel, and so on, until the entire side is finished. Thus, if there are any laps, they will occur where the panels are joined and will not show.

HOW TO AVOID "LAPPING."

In finishing a floor, start at one corner and take two or three boards only. Finish just as wide a surface at a time as the arm naturally sweeps, and paint along the same two or three boards until the entire room has

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been crossed. Always work from the unfinished into the finished portion, instead of from the finished into the unfinished.

The following woods are called open-grained woods: Walnut, ash, oak, butternut, chestnut, mahogany, prima vera or white mahogany.

All of these woods must be filled with wood filler before they can be successfully varnished. Full instructions are given under the various headings in this book.

FINISHING OPEN AND CLOSE GRAIN WOODS.

Close-grained woods do not need to be filled before varnishing. Some woods which come under this class are: Pine, birch, cypress, beech, maple, poplar or whitewood, hemlock, redwood, sycamore, cherry, gumwood and Oregon fir.

We would suggest that paraffine wax be applied to table tops with a large brush. The wax should be heated first—preferably in a double boiler, to avoid the danger of burning. In case the wax does not penetrate the wood satisfactorily, the surface may be rubbed over with a hot iron, which will melt the wax and allow it to be absorbed by the wood.

To take heat stains out of wood, take three or four thicknesses of blotting paper and lay on the spot, and place a hot smoothing iron on the paper. Have ready at hand some pieces of flannel, also folded and made quite hot. As soon as the iron has made the surface of the wood quite warm, remove the paper and go over the surface with a piece of paraffine, rubbing it hard enough to leave a coating of the substance. Then with one of the pieces of flannel rub the injured surface. Continue the rubbing, using freshly warmed cloths until the whiteness leaves the varnish or polish. The operation may have to be repeated once or twice, but it always succeeds at last.

TAKING HEAT STAINS OUT OF WOOD.

The cleansing of brushes should always be done with the liquid that was used for the solvent in the stain. Clean a brush that was used in an oil stain in benzole or naphtha, a spirit stain brush in wood alcohol. Never use an alkali, such as sal soda or ammonia on brushes. If this becomes necessary use a very weak solution. To keep varnish brushes in condition, bore

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KEEPING VARNISH BRUSHES IN CONDITION.

a hole just below the small part of the handle, about one-eight inch in diameter and suspend the brushes into a pail so that the hair is immersed in turpentine, or some turpentine substitute such as turpaline. Five or six brushes can be put in one pail by suspending them on a wire put through these holes. A cover can be made with a slot which will cover the pail and prevent excessive evaporation. These brushes will be ready for use on a moment's notice. They will always be in condition, even though they are allowed to remain a week at a time unused. The hair of the brush will remain moist as long as the bottom of the brush or end of the hair is partially immersed.

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CHAPTER LXV.

BEST PAINT FOR SMOKE STACKS.

THE trouble with smoke stack painting is that in most cases any cheap material is considered good enough. Ordinary coal tar is often employed or some cheap benzine asphaltum varnishes in which rosin and benzine are predominant and coal tar takes the place of asphaltum. It should be considered that a smoke stack is really exposed to very severe conditions, having heat passing through to the elements from without. It has to stand sun heat, warm and cold rains; the metal contracts and expands alternately, and it is obvious that only good elastic material can survive for any length of time under these conditions.

SMOKE STACK PAINT NEEDS QUALITY.

The best paint for the purpose, therefore, is somewhat of the nature of a good, black looking varnish made from genuine asphaltum, linseed oil and turpentine, entirely free from rosin, coal tar, benzine, etc. It should consist of 100 pounds of real gum asphaltum, Cuban or Trinidad, that is fused in the kettle with 20 gallons kettle-boiled linseed oil and thinned with from 20 to 25 gallons spirits of turpentine. The price asked by a varnish manufacturer for a varnish of this description may be considered high, but its use will pay in the long run, as the cost of labor in painting a stack is the chief item. This asphaltum varnish will not blister if applied properly, but will bake on the metal as the heat passes through the stack, and it will prove elastic enough to stand all the conditions that it is subjected to. Figure the cost of painting a stack three times with cheap paint and the cost of painting it once only during that time with the higher priced asphaltum varnish and note the difference in favor of the latter method.

THE BEST STACK PAINT.

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CHAPTER LXVI.

RUBBING AND POLISHING METHODS.

THE practical and universally used felt pad has supplanted all other materials for rubbing and polishing. Pads were formerly made by various methods, usually a ball of soft material such as old rags, or cloths of many kinds. The balls were covered with heavy woolen cloth.

GREAT ADVANCEMENT IN METHODS.

In earlier days the furniture factory owners were buying rags gathered from every conceivable source, clean and unclean. Today the rags used in the modern factory are thoroughly cleansed and disinfected by boiling, and by treatment in germicidal baths, and then selected for their qualifications for the purposes needed. Today when a factory purchases a bale of rags, the disease question is eliminated.

When stains are wiped, rags are chiefly employed; they are cheaper than waste and they do not leave threads over the work.

The felt pad is used as a sanding block, as well as for rubbing and polishing. In the rubbing down with pumice stone or in the polishing with rotten stone, the felt pad does the work with equal satisfaction. Some claim great qualifications for hair cloth, curled hair, burlap, steel wool and excelsior. There are occasions when their use may be successful, but unless the artisan is well acquainted with the peculiarities of each, much damage can be done in a few minutes sufficient to ruin the job.

VARIOUS METHODS EMPLOYED.

Hair cloth is rare, expensive and difficult to handle. It has a hard surface and should be discarded. Curled hair and burlap are good in Mission work; they take hold and will help to carry with each stroke considerable powder but soon become matted, and the time spent in keeping such a pad in good condition will buy good felt. Steel wool is a "quick cutter," but it breaks up when trimmings and corners are encountered, the little ends get under the trimmings, break off and then

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it takes a pair of forceps to get them out. Excelsior will do where there is nothing else, yet it is too brittle, breaks up and should be used only as a filler for a pad, using cloth to cover.

It will be found that none of the materials can produce anything like the results that the felt pad can, and the artisan who has not had experience with the various methods may rest assured there will be no loss by omitting their consideration. The few cases where burlap, curled hair or steel wool may be recommended would not warrant the purchase of them.

FELT PAD IS BEST KIND OF POLISHER.

Where rubbing and polishing is carried on without the aid of machinery, it probably is the most physically strenuous labor in the finishing department, especially true when all the rubbing is done by hand on large surfaces.

The work entails the continual use of the same muscles, practically all in one position, and it is only

MATTISON RUBBING MACHINE

recently that labor-saving devices have been offered that are really successful. Rubbing and polishing are usually carried on by the employment of felt pads. Where the work is water rubbed it is first coated, or rather pumice stone or rotten stone is sprinkled on the work; this is wet with water, and the rubbing proc-

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ess carried on in distinct straight strokes of uniform pressure with the grain. Never is this to be done crosswise. The motion and direction of the stroke should be continually the same. The same is true in oil rubbing.

In the polishing process the stroke should be with the grain but toward the finishing process can be done in a circular motion, such as in French polishing. The advent of the rubbing machine has been welcomed by many, and the following description of an accredited device will give the finisher a good idea of the possibilities of a rubbing machine.

NEVER RUB ACROSS GRAIN.

The oscillating shoes, two in number, carry pads five and one-half by four and one-half inches in size. These pads are readily detachable by hand; no tools are necessary. Various qualities of felt, as well as sandpaper, can be used. The working parts are self-oiling and the whole machine is very quiet running. It is equipped with a cord and plug, and works from any lighting socket. While not in actual operation no electricity is consumed, as the switch is on the machine itself. The cost of current to operate is one cent per hour, if the rate you have for electricity is four cents per kilowatt hour.

Wherever the work is, any such machine can be easily carried to it, attached to any nearby electric light socket, and at a turn of the switch on the machine, the two felt pads start oscillating at a rate of several hundred times a minute. The operator, by means of conveniently arranged side or top handles, guides the machine over the surface to be finished. The pads are so designed that every edge and corner will be treated as well as the center of the surface. The operator uses no pressure; the weight of the machine is the right weight to produce the highest grade of work.

COST IS A MERE TRIFLE.

Wherever rubbing or polishing is done on stone or wood, with any grade of felt or sandpaper, the machine shown here will do the work now done by hand or by air pressure, in a more efficient and more economical way.

The finish is an important part in the appearance—a vital part in the selling price—and a large part of the

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labor cost. Such machines as the one shown here will produce better polish and materially reduce cost of labor. Under the right conditions they will do many times the work of a man, and are easier and quicker to handle than the pneumatically operated rubbing machines. In addition to these economical advantages the machines produce exactly the same high grade work at four o'clock in the afternoon as they do at nine in the morning. There is no hard labor connected with operating this device—all that is necessary is for the operator to guide it over the surface.

EVERY EDGE AND CORNER REACHED.

A good pad French polisher for hand polishing which will at once give you a finish, color and serve to fill your scratches on the woodwork is the following:

Alcohol	8 ounces
Shellac	½ ounce
Gum Benzoine	¼ ounce
Poppy Oil	¼ ounce

Dissolve shellac and gum in alcohol in a warm place with frequent agitation, and when cold add the oil. Color with Bismark brown for mahogany, and for the brown woods reduce the Bismark brown and add more spirit black. For Antwerp use black and orange.

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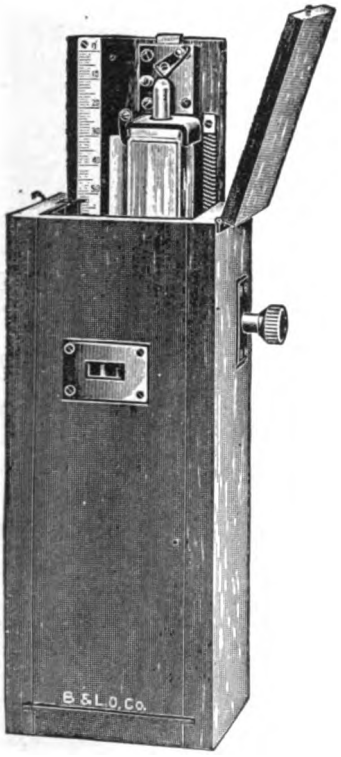
CHAPTER LXVII.

COMPARING COLOR SOLUTIONS.

THERE has come on the market an apparatus which must prove an immense convenience for the foreman finisher. This is the new colorimeter, an accurate, compact and universal instrument for comparing the colors of solutions in the minimum amount of time and with the greatest possible ease.

FOR TESTING SOLUTIONS.



THE UNIVERSAL COLORIMETER, SHOWING OBSERVATION SLIT, SCALE, ADJUSTMENT, ETC.

The Universal Colorimeter is based upon the principle of determining the value of an unknown solution by comparing its color with that of a standard solution held in a wedge-shaped container, so that a depth of the standard may be obtained corresponding exactly in color with the color of the unknown. After the colors have been properly matched, the millimeter scale is read and the plottedgraph for the standard consulted. This graph shows the milligrams of the substance sought per cubic centimeter of the solution tested, giving immediate result.

The instrument consists of a small cell for the unknown, mounted on a removable holder, and a standard wedge on a frame adjustable by rack and pinion to secure various depths of solution and, consequently,

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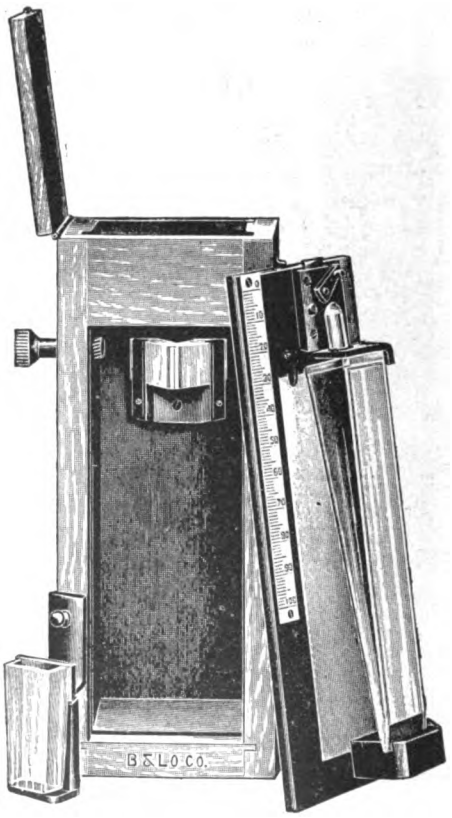
color. A millimeter scale with indicator for reading is mounted with the wedge. There is a large window of ground glass which illuminates the field with properly diffused light. The cell and the wedge are so placed in relation to a double prism as to give a field one-half of which shows the color of the wedge and the other half that of the unknown in the cell. There is no separating line between the two shades in the field, which is viewed through a small slit.

HOW THE COLORIMETER OPERATES.



COLORIMETER SHOWING DOUBLE PRISM WITHIN THE CASE; CELL, WITH MOUNTING, FOR SOLUTION UNDER EXAMINATION.

The device is contained in a compact mahogany box with front, back and interior finished in dull black.

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The accuracy attainable with this colorimeter will be apparent from these facts: There is no separating line between the two shades. The cell and the wedge have no curved surfaces. The readings are made through a small slit. The standard solution is absolutely durable, made up and calibrated once for all.

The saving in time and the convenience are apparent from the following features: The apparatus is always ready for use. A standard solution does not have to be made up each time. Readings may be made in less than one minute. Washing between different determinations is reduced to the minimum. Only a small sample is needed.

HOW SCIENCE AIDS THE ARTISAN.

The variety of work to be done with the colorimeter will determine the method to be followed. Many times have hours upon hours been given to the matching of a stain; whereas, by the use of this colorimeter, the matching problem would have been a simple matter.

Again, it brings us face to face with the progress of the scientific world and shows us how science aids the artisan if he will but equip himself. It shows the foreman where it will be to his advantage to know the metric system of weights and measures—the many ways that this little instrument can be employed in the color work in preparing stains will be self-evident from the description given. Accuracy is an important factor in the fixing of colors, and if this can be accomplished by a mathematical and scientific method, as claimed, a distinct gain has been made.

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CHAPTER LXVIII.

WEIGHTS AND MEASURES.

THE preparation of a stain, whether it be a water stain, a spirit stain, oil stain, or any kind of a stain, depends first upon the uniformity of the product to be employed and, secondly, upon accuracy in figuring the quantities for each batch. The careful operator, after he has established a formula, will take especial care not to vary in the least from the successful formula. It is better to make several batches than to make a multiple, and that I may be thoroughly understood, let me say that in this country several kinds of weights are employed and one may unwittingly ruin a batch of stain by the simple doubling or tripling of the quantity. This is due to the various kinds of weights having a different number of ounces, different number of grains to the ounce.

ACCURACY A PRIME REQUISITE.

In purchasing a scale, you may have dram weights which have 60 grains to the dram. Now, eight drams should make the ounce, or 480 grains, but you will find that many of the ounces furnished with scales have only 437½ grains. The larger your formula, the farther off your color will get. Above all things, know what your scales are made out of as far as the weights are concerned, and build your formulas on the weights that you are using. But, better than all is the adoption of the metric system which is employed in all the European countries. It is not to be expected that every foreman finisher is acquainted with the different points relative to the weights and measures, especially in this country, where there is no telling which kind of weights or measures the writer of a formula is referring to. While we have the conventional gallon, and the trade ounce, very few know that chemicals are sold with 437½ grains to the ounce, whereas, most formulas are built up by the use of 480 grains to the ounce. The metric system of weights and measures alike, on the other hand, for simplicity's sake, can be

CONFUSION OF SEVERAL STANDARDS.

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likened to our dollar. For example, a hundredth part of a dollar is a cent, a tenth is ten cents, and ten times ten make our dollar. The metric system is identical with this, differing only in the number of divisions, the smallest division being in thousandths in place of hundredths. To still further explain this, the unit is a gram, and its divisions are thousandths, hundredths, and tenths, known as millimeters, centimeters and decimeters. The difference between the weights and measures is only that one is grams, and the other is cubic centimeters. The advantage of any finishing room adopting these measures will immediately be apparent after they are in use. It is only the fear of making a change that causes many of the users of the old system to adhere to it.

METRIC SYSTEM SIMPLE

It is unfortunate that, through usage, we are using in this country a conglomeration of weights and measures. This is due to the fact that, being a new country, we had to rely upon the old countries first for supplies and then for methods. In other countries it had been found that a universal unit was absolutely essential, and thus the adoption of the metric (decimal) systems. This has been adopted by the scientific laboratories, the chemical manufacturers and scientists. The drug manufacturers and apothecaries have their text-books which give both metric and apothecary weights and measures.

A more bungling mess is hard to find than a pair of scales with weights—the weights having nothing to indicate what standard they are based upon. Were these stamped troy or avoirdupois or apothecary, it would then be easy to figure out the amount of grains or units. A dealer often cannot tell you what kind he is supplying.

WEIGHTS SHOULD BE STAMPED.

We have gone along in this way because, in many cases, it made little difference. But when one seeks to use formulas, the result of which depends upon accurate weighing, we should at least use the same weights as did the man who made the formula.

A complete tabulation follows. A careful study and comparison will show the differences. It will show the necessity of knowing what kind of weights you have.

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Some day we will have the decimal system established in this country. The schools have been teaching it for the past 30 years, but it is only lately that the pupil has been impressed with the value and absolute necessity of it being understood thoroughly.

If the foreman finisher would adopt the metric system, to begin with, let him imagine it to be just like our coinage—calling the unit 1. If he takes one-tenth part, its decimal is one, or .1; if he takes ten times the unit, it would be ten decimals, 10. Applying himself to this thought—calling his units parts—he will shortly be able to write his formula about as follows:

APPLICATION OF METRIC SYSTEM.

Nigrosine A	10.
Orange U	1.
Acid Green	.1
Picric Acid	.5
Water	1000.—

which would mean, to him, ten parts of nigrosine, one part of orange, one-tenth part acid green, etc., and 1,000 parts of water. Now, if he calls a part a dram (or 60 grains), it would be easy until he comes to weighing one-tenth of a dram. But he would have to know the number of grains to the dram. If 60, then the tenth part is six grains. If, on the other hand, he uses the metric system, he would have to select only the desired weights.

It is mainly because we are all generally under the impression that the metric system is something fierce to master that we avoid it. On the other hand, publishers of formulas feel that the people avoid any formula given in the metric system and, therefore, continue in the old rut.

TOO MANY ARE AFRAID OF METRIC SYSTEM.

Following is the schedule of weights and measures referred to:

U. S. Weights and Measures According to Existing Standards

TROY WEIGHT

Pound		Ounces		Pennyweights		Grains		Grams
1	=	12	=	240	=	5,760	=	373.24
		1	=	20	=	480	=	31.10
				1	=	24	=	1.56

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APOTHECARIES' WEIGHT

Pound		Ounces		Drams		Scruples		Grains		Grams
1	=	12	=	96	=	288	=	5,760	=	373.24
		1	=	8	=	24	=	480	=	31.10
				1	=	3	=	60	=	3.89
						1	=	20	=	1.30
								1	=	.06

The pound, ounce, and grain are the same as in Troy weight.

AVOIRDUPOIS WEIGHT

Pound		Ounces		Drams		Grains (Troy)		Grams
1	=	16	=	256	=	7,000	=	453.60
		1	=	16	=	437.5	=	28.35
				1	=	27.34	=	1.77

APOTHECARIES' WEIGHT

20 Grains	=	1 Scruple	=	20 Grains
3 Scruples	=	1 Dram	=	60 Grains
8 Drams	=	1 Ounce	=	480 Grains
12 Ounces	=	1 Pound	=	5,760 Grains

FLUID MEASURE

60 Minims	=	1 Fluid Dram
8 Drams	=	1 Fluid Ounce
16 Ounces	=	1 Pint
8 Pints	=	1 Gallon

The above weights are usually adopted in formulas.
All chemicals are usually sold by

AVOIRDUPOIS WEIGHT

27 11-32 Grains	=	1 Dram	=	27 11-32 Grains
16 Drams	=	1 Ounce	=	437½ Grains
16 Ounces	=	1 Pound	=	7,000 Grains

Precious metals are usually sold by

TROY WEIGHT

24 Grains	=	1 Pennyweight	=	24 Grains
20 Pennyweights	=	1 Ounce	=	480 Grains
12 Ounces	=	1 Pound	=	5,760 Grains

NOTE.—An ounce of metallic silver contains 480 grains, but an ounce of nitrate of silver contains only 437½ grains.

VOLUME—LIQUID

4 gills = 1 pint
2 pints = 1 quart
4 quarts = 1 gallon

Gills		Pints		Gallon		Cub. In.
32	=	8	=	1	=	231

EQUIVALENTS OF FLUID MEASURE IN METRIC

Gallon		Pints		Ounces		Drams		Minims		Cubic Centimeters
1	=	8	=	128	=	1,024	=	61,440	=	3,785.435
		1	=	16	=	128	=	7,680	=	473.179
				1	=	8	=	480	=	29.574
						1	=	60	=	3.697

16 ounces, or a pint, is sometimes called a fluid pound.

UNITED STATES FLUID MEASURE

Gal.	Pints	Ounces	Drams	Mins.	Cub. In.	Grains	Cub. C.M.
1 =	8 =	128 =	1,024 =	61,440 =	231. =	58,328.886 =	3,785.44
	1 =	16 =	128 =	7,680 =	28.875 =	7,291.1107 =	473.18
		1 =	8 =	480 =	1.8047 =	455.6944 =	29.57
			1 =	60 =	0.2256 =	56.9618 =	3.70

IMPERIAL BRITISH FLUID MEASURE

Gal.	Pints	Ounces	Drams	Mins.	Cub. In.	Grains	Cub. C.M.
1 =	8 =	160 =	1,280 =	76,800 =	277.27384 =	70,000 =	4,543.732
	1 =	20 =	160 =	9,600 =	34.65923 =	8,750 =	567.966
		1 =	8 =	480 =	1.73296 =	437.5 =	28.398
			1 =	60 =	0.21662 =	54.69 =	3.550

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THE CONVERSION OF FRENCH (METRIC) INTO ENGLISH MEASURE

1	cubic centimeter	=	17	minims			
2	cubic centimeters	=	34	minims			
3	cubic centimeters	=	51	minims			
4	cubic centimeters	=	68	minims	or 1	dram	8 minims
5	cubic centimeters	=	85	minims	or 1	dram	25 minims
6	cubic centimeters	=	101	minims	or 1	dram	41 minims
7	cubic centimeters	=	118	minims	or 1	dram	58 minims
8	cubic centimeters	=	135	minims	or 2	drams	15 minims
9	cubic centimeters	=	152	minims	or 2	drams	32 minims
10	cubic centimeters	=	169	minims	or 2	drams	49 minims
20	cubic centimeters	=	338	minims	or 5	drams	38 minims
30	cubic centimeters	=	507	minims	or 1	ounce	0 dram 27 minims
40	cubic centimeters	=	676	minims	or 1	ounce	3 drams 16 minims
50	cubic centimeters	=	845	minims	or 1	ounce	6 drams 5 minims
60	cubic centimeters	=	1014	minims	or 2	ounces	0 dram 54 minims
70	cubic centimeters	=	1183	minims	or 2	ounces	3 drams 43 minims
80	cubic centimeters	=	1352	minims	or 2	ounces	6 drams 32 minims
90	cubic centimeters	=	1521	minims	or 3	ounces	1 dram 21 minims
100	cubic centimeters	=	1690	minims	or 3	ounces	4 drams 10 minims
1000	cubic centimeters	=	1 liter = 34 fluid ounces nearly, or 2⅛ pints.				

THE CONVERSION OF FRENCH (METRIC) INTO ENGLISH WEIGHT

The following table, which contains no error greater than one-tenth of a grain, will suffice for most practical purposes:

1	gram	=	15⅖	grains.				
2	grams	=	30⅘	grains.				
3	grams	=	46⅕	grains.				
4	grams	=	61⅘	grains	or	1 dram	1⅘	grain
5	grams	=	77⅕	grains	or	1 dram	17⅕	grains
6	grams	=	92⅗	grains	or	1 dram	32⅗	grains
7	grams	=	108	grains	or	1 dram	48	grains
8	grams	=	123⅖	grains	or	2 drams	3⅖	grains
9	grams	=	138⅕	grains	or	2 drams	18⅕	grains
10	grams	=	154⅖	grains	or	2 drams	34⅖	grains
11	grams	=	169⅘	grains	or	2 drams	49⅘	grains
12	grams	=	185⅕	grains	or	3 drams	5⅕	grains
13	grams	=	200⅗	grains	or	3 drams	20⅗	grains
14	grams	=	216	grains	or	3 drams	36	grains
15	grams	=	231⅖	grains	or	3 drams	51⅖	grains
16	grams	=	247	grains	or	4 drams	7	grains
17	grams	=	262⅖	grains	or	4 drams	22⅖	grains
18	grams	=	277⅘	grains	or	4 drams	37⅘	grains
19	grams	=	293⅕	grains	or	4 drams	53⅕	grains
20	grams	=	308⅗	grains	or	5 drams	8⅗	grains
30	grams	=	463	grains	or	1 drams	43	grains
40	grams	=	617⅕	grains	or	10 drams	17⅕	grains
50	grams	=	771⅗	grains	or	12 drams	51⅗	grains
60	grams	=	926	grains	or	15 drams	26	grains
70	grams	=	1080⅕	grains	or	18 drams	0⅕	grain
80	grams	=	1234⅗	grains	or	20 drams	34⅗	grains
90	grams	=	1389	grains	or	23 drams	9	grains
100	grams	=	1543⅕	grains	or	25 drams	43⅕	grains
1000	grams	=	1 kilogram = 32 oz., 1 dr., 12⅘ gr.					

Metric System of Weights and Measures

MEASURES OF VOLUME

Denominations and Values			Equivalents in Use		
Names	No. of Liters	Cubic Measures	Dry Measure		Wine Measure
Kiloliter or stere...	1,000	1 cu. meter	1,308	cu. yards	264.17 gallons
Hectoliter...	100	1-10th cu. meter	2	bu.and3.35 pecks	26.417 gallons
Dekaliter....	10	10 cu. decimeters	9.08	quarts	2.6417 gallons
Liter.....	1	1 cu. decimeter	.908	quart	1.0567 quarts
Deciliter....	1-10	1-10th cu. decimeter	6.1023	cu. inches	.845 gill
Centiliter...	1-100	10 cu. centimeters	.6102	cu. inch	.338 fluid oz.
Milliliter....	1-1000	1 cu. centimeter	.061	cu. inch	.27 fl. drm.

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WEIGHTS

Denominations and Values			Equivalents in Use	
	Number of Grams	Weight of Volume of Water at its Maximum Density	Avoirdupois Weight	
Millier or Tonneau....	1,000,000	1 cu. meter	2204.6	pounds
Quintal.....	100,000	1 hectoliter	220.46	pounds
Myriagram.....	10,000	10 liters	22.046	pounds
Kilogram or Kilo.....	1,000	1 liter	2.2046	pounds
Hectogram.....	100	1 deciliter	3.5274	ounces
Dekagram.....	10	10 cu. cent'rs.	.3527	ounce
Gram.....	1	1 cu. cen.	15.432	grains
Decigram.....	1-10	1-10th of a cu. cen.	1.5432	grain
Centigram.....	1-100	10 cu. mill'rs.	.1543	grain
Milligram.....	1-1000	1 cu. mill'r.	.0154	grain

For measuring surfaces, the square dekameter is used under the term of Are; the hectare, or 100 ares, is equal to about 2½ acres. The unit of capacity is the cubic decimeter or Liter, and the series of measures is formed in the same way as in the case of the table of length. The cubic meter is the unit of measure for solid bodies and is termed Stere. The unit of weight is the Gram which is the weight of one cubic centimeter of pure water weighed in a vacuum at the temperature of 4 deg. Cent. or 39.2 deg. Fahr., which is about its temperature of maximum density. In practice, the term cubic centimeter, abbreviated c. c., is generally used instead of milliliter, and cubic meter instead of kiloliter.

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CHAPTER LXIX.

STAIN FORMULAS.

THE following formulas have been given in materials of uniform strength which can be found in the market. It must be realized that the entire value of stain formulas depends upon the uniformity of the ingredients used, a uniformity that extends into the percentage of color-value of the aniline employed.

The formulas given will produce the correct conventional shade and method of finish. It, therefore, will be seen that any material difference in the color-value or shade of an aniline employed will not attain these results. Realizing that there may be occasional difficulty in obtaining colors identical with those employed in the production of these formulas, the publishers have arranged to furnish gratis, upon receipt of sufficient return postage, sample of such color that will enable the artisan to compare materials at hand and to provide himself with identical goods. Note final chapter.

ANTIQUE MAHOGANY.

FORMULA:

Mahogany Brown	2 ounces
Mahogany Red	1 ounce
Potassium Bichromate	½ ounce
Water	1 gallon

DIRECTIONS:

Apply two coats and proceed in the usual manner with the finish. Color of filler usually very dark. Under "Antique" we have many shades, all of which can be produced from above ingredients.

AUSTRIAN OAK.

Austrian oak, like Hungarian oak, is not a general finish, the procedure being the same as for producing Baronial oak.

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ANTWERP OIL STAIN.

FORMULA:

Oil Black	4 ounces
Oil Yellow (light)	6 drams
Oil Red (bright)	80 grains
Boiled Oil	1 pint
Turpentine	1 pint
Naphtha	1 gallon

DIRECTIONS:

Cut the color material in the turpentine by heating on a water bath, then add the oil. When cool add naphtha, using same to rinse dish in which original solution was made. One coat of this followed with a coat of white shellac. Filler to be black and put over the shellac coat. Then give a second coat of shellac and two coats of white varnish. Rub flat.

BARONIAL OAK "A."

FORMULA:

Brown Mahogany Stain Powder	½ ounce
Jet Black Nigrosine	30 grains
Walnut Crystals Powdered	30 grains
Bichromate of Potash	1 dram
Water	1 gallon

DIRECTIONS:

Dissolve stain powders in warm water and apply first coat freely. This coat may constitute the sponging coat. Sand smoothly and apply second coat of same stain. Do not sand this coat but give a good coating of white shellac, or if preferred, white japan. When dry, wax. This finish is not filled.

BARONIAL OAK "B."

FORMULA:

Brown Mahogany Stain Powder	1 ounce
Nigrosine Jet Black	1 dram
Bichromate of Potash	1 dram
Water	1 gallon

DIRECTIONS:

Dissolve stain powder and after the wood is sponged, apply stain. Do not wipe but see that same is well brushed out. When dry sand lightly and then coat with white shellac, and sand with 00 sandpaper. Give two coats of some good flat varnish or wax.

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YOUR OWN FORMULAS

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BELGIAN OAK.

FORMULA:

Walnut Brown Crystals, ground	4 ounces
Bichromate of Potash	1 ounce
Nigrosine Jet Black	4 ounces
Naphthol Black	½ ounce
Mahogany Brown	½ ounce
Water	1 gallon

DIRECTIONS:

Dissolve powders in hot water. Apply first coat, sanding same without cutting through stain coat. Then give second coat of stain and when dry, without sanding, apply solution of oil black made by cutting one ounce of oil black aniline in one quart of white japan. This can be best accomplished by heating turpentine on a water bath and in it dissolving the oil black. Then while warm add to the japan. When this black coat is thoroughly dry, wax.

BOG OAK.

FORMULA:

Sap Brown or Walnut Brown	1 ounce
Bichromate of Potash	2 drams
Nigrosine Jet Black	1 ounce
Mahogany Brown Stain Powder	1 dram
Water	4 gallons

DIRECTIONS:

Apply first coat of stain, throughly brushing well into wood. Sand well, and apply second coat but do not sand second coat. Fill with dark filler colored by using two part of Van Dyke brown and one part of drop black.

BUTLER OAK.

FIRST COAT FORMULA:

Catechu	½ pound
Lye	½ pound
Water	2 gallons

SECOND COAT FORMULA:

Black P. B.	135 grains
Naphthol Yellow	12 grains
Water	1 gallon

DIRECTIONS:

After preparing first coat as per formula, use one cunce

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of the solution to ten ounces of water. With this stain the wood, sand and apply second coat. Then fill with a black filler, this to be a natural filler colored with drop black in oil. Shellac using white shellac, sand lightly and give two coats of light varnish. Rub dull with oil. For Butler oak, nothing serves better than an oil rub finish.

CATHEDRAL OAK (Old).

FIRST COAT FORMULA:

Bichromate of Potash	2 drams
Naphthol Yellow	1 dram
Water	1 gallon

SECOND COAT FORMULA:

Bichromate of Potash	1 dram
Sap Brown or Walnut Crystals	4 drams
Jet Black Nigrosine	4 drams
Naphthalene Black	½ dram
Water	4 gallons

DIRECTIONS:

Apply first coat freely. This may also constitute the sponging coat. Sand carefully and apply second coat. Shellac and varnish, rub dull to dead finish.

CATHEDRAL OAK (New).

FORMULA:

Sap Brown or Walnut Crystals	2 ounces
Black P. B.	¼ ounce
Naphthol Scarlet	15 grains
Bichromate of Potash	1 dram
Water	3 quarts

DIRECTIONS:

For the first coat, which may also be the sponging coat, dissolve two drams of Lewis' or Babbitt's lye, or carbonate of potash, in a gallon of water. Then when dry, sand carefully. Apply stain when dry and see that work is well smoothed. Then apply solution made of three parts boiled oil, one part asphaltum varnish, six parts naphtha. Clean and rub dry with rags or waste. The next day shellac and wax.

CHERRY STAIN ON BIRCH.

FORMULA:

Mahogany Brown	2½ ounces
Naphthol Scarlet	1 ounce
Potassium Bichromate	½ ounce
Water	8 gallons

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DIRECTIONS:

Prepare the work in usual manner, that is, as if stain is to be used on cherry wood and apply the stain, wiping it off. If on birch, maple or other substitute woods, apply thoroughly and brush out well. No filler is required. Little grain will be raised. On high grade work sand before shellacing. On fixtures, etc., do this after the shellac coat has been applied. Use equal parts of white and orange shellac. Finish as required.

CHERRY STAIN ON PINE.

FORMULA:

Mahogany Brown	2 ounces
Naphthol Scarlet	10 ounces
Potassium Bichromate	1 ounce
Water	6 gallons

DIRECTIONS:

This will produce a good penetrating cherry stain devoid of that scarlet shade which is often found in prepared cherry stains and absolutely incorrect. The sanding can be done after the shellac coat has been applied.

CHIPPENDALE ACID STAIN.

FORMULA:

Black P. B.	1 ounce
Bichromate of potash	2 ounces
Mahogany Red	60 grams
Water	3 gallons

DIRECTIONS:

Give one coat of stain filler colored with Van Dyke, burnt sienna and rose pink. Hold to a decided brown shade. Use brown shellac and white or very light colored varnish.

CHINESE TEAK.

FIRST COAT FORMULA:

Mahogany Red Stain Powder	4 ounces
Naphthol Yellow	1 ounce
Potassium Bichromate	½ ounce
Water	3 gallons

SECOND COAT FORMULA:

Antwerp Stain Powder (1st formula)	4 ounces
Water	1 gallon

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DIRECTIONS:

Apply the first coat as prepared according to the above formula, and when dry, sand the work thoroughly. Then apply the second coat, but do not sand.

Fill with a filler which has been colored so it has almost a black appearance with three-fourths part of drop black, ground in oil, and one-fourth part Van Dyke brown, ground in oil. Clean the filler off well, and give one coat

DUTCH BROWN OAK.

FIRST COAT FORMULA:

Mahogany Red Stain Powder	4 ounces
Naphthol Yellow	2 ounces
Potassium Bichromate	1 ounce
Water	3 gallons

SECOND COAT FORMULA:

Ground Walnut Crystals	6 ounces
Mahogany Brown Stain Powder	5 ounces
Water	2 gallons

DIRECTIONS:

Dissolve the first coat in the water. This may be applied freely, and thus serve as the sponging coat, as well as the first stain coat. Sand down thoroughly, then apply the second coat. In preparing the second coat, boiling water should be used, and the stain allowed to cool and settle. Then pour off the clear liquid, and strain the last liquor through a few folds of cheese cloth. Apply and sand very lightly. Fill with a filler colored quite dark with Van Dyke brown, ground in oil. Shellac, varnish and rub dull. If a cheaper finish is desired, three coats of flat finish may be used.

DRIFT WOOD (Old Method).

FORMULA:

Unslacked Lime	5 pounds
Water	2 gallons

DIRECTIONS:

After the lime has slacked, pour off clear liquid and give the work a thorough sponging. Smooth down with sandpaper and coat with wax into which is sifted carbonate of zinc and just enough dry drop black to give a slight gray tone. The wax should be thin so as to spread easily, to be rubbed well out. When dry, give second coat of wax.

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DRIFT WOOD (New Method).

FORMULA:

Sulphate of Iron dried	60 grains
Black P. B.	¼ ounce
Oxalic acid	60 grains
Water	3 gallons

DIRECTIONS:

To prepare drift wood finish (usually on oak) omit the sponging coat, using the stain on the sanded work. After the stain has stood 12 hours in a well ventilated room, sand down well. Put a small amount of zinc white in the wax, just enough to give the pores a grayish tint, but not to fill them. Then a second coat of wax which is rubbed to polish.

EARLY ENGLISH (Windsor).

FORMULA:

Picric acid	4 ounces
Nigrosine Jet Black, H. & M.	6½ pounds
Mahogany Brown	1¼ pounds

Of this powder, usually three ounces to the gallon of water produces the shade desired. Finishing procedure same as above, although many makers add a little Van Dyke brown to their filler.

EARLY ENGLISH (Spirit Stain).

FORMULA:

Spirit Black	4 ounces
Auramine	½ ounce
Malachite Green	⅛ ounce
Wood Alcohol	1 gallon

A spirit stain is not as satisfactcry a way to produce Early English. The pores are not open and the amount of filler that the wood will take on is not sufficient to produce the effect.

EARLY ENGLISH (Oil Stain).

FORMULA:

Oil Black	1¼ pounds
Oil yellow	2½ ounces
Oil Brown	½ ounce
Linseed Oil	¾ pint
Turpentine	1 quart
Naphtha	1 gallon

This mixture is prepared as follows: Heat the turpentine

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on a water bath and in it melt the colors. Then, when melted, add the linseed oil and when cool add the naphtha.

This gives a base for producing Early English. It must be thinned with gasoline or benzo, however, to produce the desired depth of color. The stain must be allowed to stand until thoroughly dry before an attempt be made to fill the work. The same ingredients can be cut by the use of benzo in place of the hot turpentine, and if it is desired to increase the penetrating powers, add four ounces of acetone to each gallon of stain. This will greatly facilitate the binding of the stain into the wood.

EARLY ENGLISH.

FORMULA:

Nigrosine, Jet Black, soluble in water	1 pound
Water, hot	7 gallons

To produce greenish shade:

Dissolve Picric Acid	1 ounce
Water or Alcohol	12 ounces

DIRECTIONS:

Add to the nigrosine solution as much of the picric acid solution as required to produce the shade desired. Sponge the wood and sand. Then apply stain, giving one good coat. When dry, sandpaper, dust and fill with black filler. Any good natural filler may be colored black by adding drop black. Early English may be shellaced, varnished and rubbed flat, or flat finish may be put over the shellac coat. Some prefer to wax it.

EARLY ENGLISH (One Coat).

FORMULA:

Sulphur Brown "M"	2 ounces
Black P. B.	4 ounces
Lye	¼ ounce
Water	1 gal. 3 qts.

DIRECTIONS:

After work has been sponged and sanded, apply thoroughly. When dry, sand lightly with finishing paper, sand just enough to remove the fibers. Prepare the filler by coloring natural filler with equal parts of Van Dyke brown, ground in oil, and drop black ground in oil. After filling, let work stand 24 hours. Then apply shellac, using two parts of white to one part of orange. Sand the shellac coat lightly and coat with flat Mission finish or wax. If better finish is desired the Mission can be oil rubbed.

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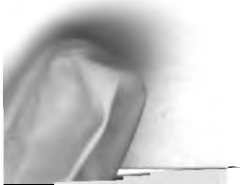

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EARLY ENGLISH (Standard).

FORMULA:

Walnut Crystals (ground)	2 ounces
Black P. B.	1 ounce
Water	1 gallon

DIRECTIONS:

First sponge the wood with a solution of one-half ounce of lye to a gallon of water. Sand and apply the stain. Fill with a dark filler colored with drop black, ground in oil. Then apply one coat of white shellac. Sand with 00 sandpaper and give one or two coats of white varnish and rub dull. Some finish in wax, others prefer flat finish, but Early English proper should be finished with varnish.

EARLY ENGLISH (Oil Stain).

FORMULA:

Oak Stain No. 53 H. & M.	1 ounce
Oak Stain No. 37 H. & M.	½ ounce
Benzole	3 ounces
Oil of Mirbane	¼ ounce
Japan	3 ounces
Naphtha	16 ounces
Turpentine	2 ounces

DIRECTIONS:

Cut the stain powders with the benzole and slowly add turpentine until the color is all dissolved, or heat the turpentine on water bath and cut the color while turpentine is hot. Next add the japan and as the mixture cools, add other ingredients.

After the work is smoothed and ready for stain, dust it off carefully and apply stain. Do not fill till second day. Filler to be colored with two parts Van Dyke brown and one part drop black. Let filler dry well, then coat with shellac two parts white shellac and one part orange. Sand lightly and coat with flat varnish or flat Mission finish.

ENGLISH OAK.

FORMULA:

Walnut Crystals ground	10 ounces
Lye, such as Babbitt's	¼ ounce
Water	1 gallon

DIRECTIONS:

It will be noticed that this is very nearly the same as walnut stain, the only differing feature being the filler which should have the Van Dyke brown color and the

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final finish, which should be correct. It is a high polish, usually produced with two coats of shellac and varnish polished.

EBONY STAIN.

FORMULA:

Solid Extract of Logwood.....3 ounces
Water .....½ gallon

DIRECTIONS:

Tie the broken pieces of logwood extract in a cotton cloth and place in the water which should be allowed to boil until the liquid is reduced one half. Remove the cloth which will contain but a small amount of fibrous inert matter. To the warm solution of logwood, add two-thirds ounce of powdered sal soda or one-third ounce of dried carbonate of soda. Stir this gradually into the warm solution and remove the resultant foam. Should the solution be cooled, then heat again and apply to the wood or if convenient, dip the wood. If first operation does not penetrate thoroughly, repeat the operation. After the wood has dried, apply a hot solution of bichromate of potash or soda, using one and two-thirds ounces to the quart of water. A deep rich color will result. For small articles, the dipping process is recommended. This produces a much deeper penetration than any other known method.

The following formulas will produce excellent blacks and being made up of material to be found in any market are of value because the black color can be changed so as to produce many of the modern stains by the admixture of such colors as red, yellow and orange.

FORMULA No. 1:

Logwood Chips.....6 pounds
Powdered Verdigris.....½ pound
Copperas .....½ pound
Bruised Nutgalls.....4 ounces
Water .....10 gallons
Boil for two hours, then add one gallon of vinegar, and boil for one more hour.

FORMULA No. 2:

Logwood Chips .....½ pound
Pearl Ash .....1 ounce
Boiling Hot Water.....2 quarts
Apply hot to the wood.

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FORMULA B:

Logwood Chips	½ pound
Verdigris	½ ounce
Copperas	½ ounce

Boil in two quarts of water. Second coat.

FORMULA No. 3:

Logwood Extract	1 pound
Water	3 gallons
Copperas	1 pound

Boil for two hours.

FORMULA No. 4:

Logwood Extract	1 pound
Copperas	1½ pounds
Powdered Nutgalls	2 pounds
Water	5 gallons

Boil for two hours.

FORMULA No. 5:

Nigrosine	4 ounces
Acetic Acid	4 ounces
Water	1 gallon

Apply two coats.

EARLY ENGLISH (Antique).

Sometimes called Royal Early English.

FIRST COAT FORMULA:

Walnut Crystals	½ ounce
Mahogany Brown	1 dram
Lye (Carbonate of Potash)	½ ounce
Water	2½ gallons

SECOND COAT FORMULA:

Tincture of Iron	½ ounce
Black P. B.	¾ ounce
Walnut Crystals	¼ ounce
Water	1 gallon

DIRECTIONS:

The first coat should be applied thoroughly, as it constitutes the sponging coat. When dry, sand it well and apply second coat. When dry, give a thin coat of shellac and sand lightly, then fill. Filler to be almost black, just enough Van Dyke brown to be used to take off the coal black shade. Let stand 48 hours and give one coat of

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shellac, using three parts of white and one part of orange. Sand and wax or give good flat finish.

FOREST GREEN.

FIRST COAT FORMULA:

Acid Green "E"	2¼ ounces
Water	1 gallon

SECOND COAT FORMULA:

Picric Acid	½ ounce
Water	1 gallon

DIRECTIONS:

The wood to be prepared in usual manner. First coat applied and sanded lightly. Then apply second coat. This serves as a mordant. After this is dry, fill with a filler which is colored with chrome green and drop black. Some add a bit of brown. Shellac and finish to suit.

FLANDERS (Stain Method).

FIRST COAT FORMULA:

Bichromate of Potash	2 ounces
Caustic Soda (stick)	1 ounce
Water	1 gallon

SECOND COAT FORMULA:

Nigrosine, Jet Black	2 ounces
Sulphate of Iron, dried	1 dram
Acid Brown	2 ounces
Water	1 gallon

DIRECTIONS:

The first coat constitutes sponging coat as well as stain coat. It is sanded thoroughly, and the second coat is applied. When dry, coat without sanding with a mixture of two parts japan, two parts boiled oil and four parts naphtha. Let this dry well, and rub down when dry. Properly speaking, Flanders should not be filled. If, however, it is requested, color your filler with equal parts of drop black and burnt umber. Then shellac. If not filled, use repeated coats of the oil mixture and rub until a good, smooth matte surface is obtained.

FUMED OAK "A."

FIRST COAT FORMULA:

Bichromate of Potash	4 ounces
Carbonate of Potash	1 ounce
Water	5 quarts

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SECOND COAT FORMULA:

Blue, Extra Blue	1 ounce
Scarlet 2R	60 grains
Water	2 gallons

DIRECTIONS:

After applying the first coat of stain, let the work stand over night, then sand smooth, and coat with a mixture of one part boiled oil and three parts naphtha. To each quart of this oily mixture add one ounce (liquid measure) of japan drier.

The following day, stain over this coat, which by this time should have thoroughly penetrated the wood, with the second coat. If there is any difficulty in making the stain take hold, rub the spot with rags, and then go over again with the stain. Do not sand this coat, but go over the work with japan drier to which one pint of turpentine has been added to each gallon. See that a uniform covering is produced. When it is thoroughly dry, finish in wax.

FUMED OAK "B."

FIRST COAT FORMULA:

Bichromate of Potash	½ ounce
Carbonate of Potash, or Soda if dried	½ ounce
Water	1 gallon

SECOND COAT FORMULA:

Nigrosine, Jet Black	¾ ounce
Walnut Brown Powder	4 ounces
Water	1 gallon

DIRECTIONS:

Apply the first coat, and when dry, sandpaper, dust off. Then apply a mixture of one part of boiled oil and five parts of naphtha. Allow to stand not less than six hours, rubbing off the oil spots with rags, and then apply second coat. If oil spots show through the stain, wipe them off well with waste or rags, and stain again. When this coat is thoroughly dry, coat with white shellac. If any wood fibers show through the shellac coat, they can easily be cut off by going over the shellac coat carefully with sandpaper. In this operation, however, care should be taken not to cut through the shellac. Dust off, and apply wax.

FUMED OAK "C."

FIRST COAT FORMULA:

Bichromate of Potash	2 ounces
Orange Y	30 grains
Naphthol Yellow	30 grains
Water	1 gallon

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FOR THE CLEANING OF LEATHER

YOUR OWN FORMULAS

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YOUR OWN FORMULAS

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This mixture is applied to the surface and left on for some time. It is then brushed off, and takes the paint away with it. It keeps moist quite long enough to be easily removed after it has acted.

PASTE FOR REMOVING OLD PAINT OR VARNISH COATS.

PASTE THAT REMOVES OLD PAINT.

1.	Sodium Hydrate	5 parts
	Soluble Soda Glass	3 parts
	Flour Paste	6 parts
	Water	4 parts
2.	Soap	10 parts
	Potassium Hydrate	7 parts
	Potassium Silicate	2 parts

TO REMOVE OLD ENAMEL.

Lay the articles horizontally in a vessel containing a concentrated solution of alum and boil them. The solution should be just sufficient to cover the pieces. In 20 or 25 minutes the old enamel will fall into dust, and the article can be polished with emery. If narrow and deep vessels are used, the operation will require more time.

TO CHANGE A FINISH.

CHANGING A FINISH.

Hardly a factory exists that does not have occasion to use a varnish remover, but still a greater demand exists for spasmodic use of this article in the retail furniture store. In the former it is often called upon because a finish has gone wrong, or the shade is not as ordered, or a piece finished one way and in stock would be found preferable to change the finish rather than to run a new one through the factory. In the latter, we will say that golden oak chairs are on the floor, but Mrs. Brown would like them in Early English —to match a certain dining room table that particularly struck her fancy. It is a well-known fact that the larger furniture stores have a finisher, whose duty is to do this transformation act. He needs a bit of varnish remover, and with formulas at both of these places it is an easy matter to prepare this commodity when required.

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Here, then, are two formulas, either one of which may be used with success.

THE FORMULAS THAT WILL DO IT.

Benzole	5	quarts
Acetone	2½	pints
Carbon Bisulphide	½	pint
Paraffine Wax	2	ounces

Mix in order given, or

Benzole	1	gallon
Fusel Oil	1	pint
Acetone	1	pint
Paraffine Wax	1½	ounces

One has only to get the market price on these articles and figure the cost of a gallon to convince himself that the formula is an asset. That either of these formulas will do the work is a fact readily established.

TO CLEAN BRUSHES AND VESSELS OF DRY PAINT.

The cleaning of the brushes and vessels in which the varnish or oil paint have dried is usually done by boiling with soda solution. This frequently spoils the brushes or cracks the vessels, if of glass; besides, the process is rather slow and dirty. A more suitable remedy is amyl acetate, which is a liquid with a pleasant odor of fruit drops, used mainly for dissolving and cementing celluloid. If amyl acetate is poured over a paint brush the varnish or hardened paint dissolves almost immediately and the brush is rendered serviceable at once. If necessary, the process is repeated. For cleaning vessels shake the liquid about in them, which softens the paint so it can be readily removed with paper; in this manner much labor can be saved.

HOW TO CLEAN UP A HARD BRUSH.

The amyl acetate can easily be removed from the brushes, etc., by alcohol or oil of turpentine.

TO REMOVE OLD OIL, PAINT OR VARNISH COATS.

1. Apply a mixture of about five parts of potassium silicate (water glass, 36 per cent), about one part soda lye (40 per cent), and one part of ammonia. The composition dissolves the old varnish coat, as well as

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the paint, down to the bottom. The varnish coatings which are to be removed may be brushed off or left for days in a hardened state. Upon being thoroughly moistened with water, the old varnish may be readily washed off, the lacquer as well as the oil paint coming off completely. The ammonia otherwise employed dissolves the varnish, but not the paint.

ANOTHER PAINT REMOVER.

2. Apply a mixture of one part oil of turpentine and two parts of ammonia. This is effective, even if the coatings withstand the strongest lye. The two liquids are shaken in a bottle until they mix like milk. The mixture is applied to the coating with a little oakum; after a few minutes the old paint can be wiped off.

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CHAPTER LXXX:

WOOD PUTTY AND FILLERS.

BY mixing some sawdust of the wood that is to be puttied with glue-size and coloring, a filler for nail holes, etc., may be made that will defy detection, if skillfully used. This is the common cement or putty used for the purpose, but there are others.

MAKING WOOD PUTTY AND FILLERS.

A very hard cement may be made by melting an ounce of brown rosin and an ounce of beeswax in an iron pan, and, when the two substances are perfectly melted, add any desired coloring, say Venetian red, yellow ochre, and so on. This cement must be used while hot, for it will become hard as stone upon cooling and will adhere perfectly to the wood.

A sawdust cement may be made by dissolving one ounce of the best cabinet glue in 16 ounces of water—hot, of course—and when the glue has dissolved and the size has been allowed to become cold, stir in some sawdust of the right kind (that of the wood that is to be filled, or coloring may be added), then add some whiting, to form a putty. This makes a very satisfactory cement.

A cement may be made of fresh dry slaked lime one part, rye flour two parts, with enough raw linseed oil to form a putty; varnish may be used instead of the oil, making the cement tougher. Add any desired coloring.

CEMENTS FOR FILLERS.

Still another cement: Add together equal parts of red lead, white lead, litharge and pulverized chalk, all dry, and mix into a putty with raw linseed oil and a little varnish.

CABINETMAKER'S STOPPING.

Cabinetmaker's stopping is made as follows: Place a tablespoonful of gum shellac, a teaspoonful of pulverized rosin and a bit of beeswax, the size of a hulled walnut, all into a cup or small iron pot, and place on fire to melt; then it may be used like sealing wax. Any

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desired coloring may be added to match the wood it is to be used on. The stick form, when wanted for use, may be softened by holding in the blaze of a candle and allowing the melted portion to run into the crack or device it is desired to fill. An electric soldering iron is ideal for this purpose. The filling may be levelled off with a chisel or painter's putty knife.

HARDWOOD CEMENT.

STOPPING FOR CABINET-MAKER'S WORK.

On hardwood finish, when it is desired to stop nail or other holes, etc., it is better to do it after one or two coats of shellac or other coating have been applied. The idea is to allow the shellac or other coating to bring out the color of the wood as it will appear in the finish, when you can match that color with your cement. If anything, the putty or cement should be a trifle darker than the wood, for the wood will become slightly darker in time, and then the putty will be just right.

Whiting putty for hardwood finish should be made from dry white lead, not whiting, for the lead gives clearer color where the cement is to be colored, besides which the white lead putty, especially if a little varnish is added, will not shrink as whiting putty will. Some, however, advise the use of a little whiting, too, though I do not know why. A good formula for such a putty would be as follows: Dry white lead, three-fourths and best Gilder's whiting, one-fourth, all mixed to a stiff paste with boiled linseed oil, or raw oil and a little rubbing varnish.

CRACK FILLERS.

HARDWOOD CRACK FILLER.

This crack filler can be used on any wood without discoloring the wood, that is, on light wood. For dark wood you will perhaps have to color it a little to match the wood. Where the work is to be stained it will take the color of stain.

Cornstarch	1 part
Wheat Flour	1 part
Japan Drier	1 part
Linseed Oil	1 part

Mix the flour and starch first. Then stir in the japan drier to which has been added the linseed oil,

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and mix as thick as putty or to be in easy working shape. It is intended for large cracks and openings. It must, however, be given plenty of time to dry. If applied before the piece is finished, it will take the stain, but if it is to be used on finished work, it should be colored with pigment or oil soluble colors.

ANOTHER HARDWOOD CRACK FILLER.

FOR WORK ON MAHOGANY.

Dissolve one ounce of borax in one-half pint of water; mix four ounces of fine hardwood sawdust, eight ounces of silex and one ounce of stucco; pour two ounces of boiled linseed oil drop by drop into the borax mixture so that it creams; then beat the dry powder and the liquid into a paste.

FINE CRACKS IN MAHOGANY.

Mix up some dry Venetian red with thick gum Arabic mucilage into a putty, and press this well into the cracks. The same remedy will apply to other woods, observing only the color the putty should be.

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CHAPTER LXXXI.

FOR THE CLEANING OF LEATHER.

THE following formulas and methods are recommended for cleaning all kinds of leathers which are to be redressed with polish lacquer or shellac.

CLEANING LEATHER; RENEWING COLOR.

When the color has been removed in spots or around the edges, etc., from wear or otherwise, replace it by preparing a dye that matches the original shade. It will be found, in most cases, that a water soluble aniline will do the work. Then apply a strong solution to the worn portion and go over the entire surface. This will produce a uniform color. This will be held and brought out with a coat of lacquer, wax polish, or thin shellac. Spirit colors are good where the leather is not subjected to strong light. In this case, the color can be put in the lacquer or shellac coat. Here are some formulas which may be used in preparing stains of this kind and for this purpose.

FOR TAN OR RUSSET LEATHER AND LIGHT COLORS.—Tragacanth, two drams; oxalic acid, three drams; water, 32 fluid ounces. Mix and dissolve. The liquid should be colored yellowish with aniline yellow or saffron.

VARIOUS METHODS.

FOR BLACK AND DARK COLORED LEATHER.—Yellow wax, four avoirdupois ounces; raw linseed oil, six fluid ounces; oil of turpentine, 20 fluid ounces; soap, two and one-half avoirdupois ounces; hot water, 28 fluid ounces. Melt the wax at a gentle heat, then cautiously incorporate the two oils. The soap which may be the ordinary yellow bar should be in shavings and then be dissolved in water. Now mix the two liquids, adding sufficient nigrosine to color. Without the nigrosine the mixture may be used to color tan leathers.

FOR A COMBINATION PREPARATION.—Yellow wax, four ounces; potassium carbonate, four drams; rosin soap, two drams; oil of turpentine, eight ounces; aniline yellow (phosphine), four grains; water q. s. To 12 ounces of water contained in a suitable pot, add the

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wax and the soap and scrapings, together with the potassium carbonate, and boil until a smooth, creamy mass is obtained. Remove the heat; add the turpentine and the dye, the last named having been dissolved in alcohol. Mix thoroughly and add sufficient water to make the product measure 24 ounces.

The paste which is used with the liquid application is composed of yellow wax and rosin, thinned with petrolatum 12 parts, mixed according to art.

PASTE AND POLISH HELPS.

A simpler form of the liquid polish is made by dissolving equal parts of yellow wax and palm oil in three parts of oil of turpentine:

Yellow Wax or Ceresin	3 ounces
Spermaceti	1 ounce
Oil of Turpentine	11 ounces
Asphalt Varnish	1 ounce
Borax	80 grains
Frankfort Black	1 ounce
Prussian Blue	2½ drams
Oil of Mirbane	1½ drams

Melt the wax, add the borax, and stir until a kind of jelly has been formed; in another pan melt the spermaceti; add the varnish, previously mixed with the turpentine; stir well and add the wax; lastly, add the colors, mix well and incorporate the oil of mirbane.

WATER DRESSING.

For the preparation of the water dressings, as a general proposition, only those waxes are available which are capable of being emulsified, including carnauba; beeswax, japan and insect wax and shellac. Paraffine, ceresin and mineral waxes are not available. In order to produce an emulsion, it is necessary to use a small amount of neutral soap in addition to the required amount of alkali, though care must be taken to avoid an excess of soap, as this would make the resulting paste too readily soluble in water. Dressings of this class are made by heating the soap, alkali, wax and water to nearly the boiling point of water, stirring constantly until a uniform milky mixture is produced which, on cooling, solidifies into a mass of the consistency of an ointment.

Particularly in furniture store repair shops, is

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the finisher called upon to refinish leather, sometimes to replace the color and the outer dressing.

Where the leather is worn and roughened, coat with a glue size, which acts as a filler for this porous leather. It must be remembered that should a stain coat be put on this roughened surface the absorption of color would be so great as to cause a much darker shade. After the leather has been sized, prepare a stain, either a water stain or a spirit stain that will match, and apply it lightly until all of the roughened leather has been stained to match. When this is thoroughly dry, give a thin coat of shellac or lacquer. Where shellac is used it is better to bring the leather to a polish by repeated coats of thin wax. The oil in the wax combines with the shellac in sufficient quantity to render it elastic, so that it will not break or crack with the bending of the leather.

REFINISHING ROUGH LEATHER.

On upholstered furniture, particularly where the edges have been badly worn or broken, it is well to attempt to rearrange the springs in such a manner that the folds will come elsewhere. In other words, so that the creases and folds of the leather will change and the repaired part not be put to the extreme use that it had been originally.

Color may be incorporated either in the shellac or the lacquer, and this acts as a staining and filling coat all at once. If it is desired that either the shellac or the lacquer coat shall be the finishing coat, then give uncolored coats as such. Never leave as the final coat one that has been colored, as it is apt to crock, and as spirit colors are partially soluble in water, stains are apt to occur when any moisture comes in contact with the leather, which, of course, necessitates a final coating.

AVOID COLOR IN LAST COAT OF FINISH.

Leather upholstering frequently is bruised on the sales floor, in the stock rooms, or in transit. Where the bruise is slight, this treatment often will be found sufficient: Take a small piece of leather of some color, grained, moisten slight on the grained side, and work easily over the bruise. Polish with dry leather.

When the scratch is deep it should be touched lightly with oil stain of color to match. Rub just before dry-

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ing with the smooth side of a soft piece of leather.

Leather upholstered chairs should never be permitted to stand long near stoves or radiators. Heat dries the finish, which then is easily cracked. When leather shows signs of so "aging," the following treatment will rejuvenate it:

OTHER HINTS FOR CARE AND FINISH OF LEATHER.

Mix four parts of water with one of rich cream. Dip rag in this and apply to leather, rubbing the mixture well into the grain. Wipe off immediately after application with warm rag. Little or no pressure should be used in the rubbing to dry if the dull finish is to be retained.

This treatment may profitably be given to the leather chairs in the home at housecleaning time. The housewife should know also of the livening effect of a little warm water and soap suds, quickly rubbed off with a warm rag, on her leather upholstering.

Leather chairs should never be permitted to remain long on display near windows where the sun can strike them, as all leather will fade to some extent if exposed continually to sunlight. The grain leather is the more quickly affected.

Leather goods received in the winter should always be allowed at least 24 hours in a warm room before unpacking or handling. After exposure to cold, leather is stiff and liable to crack when handled.

A little usage now and then is better for the leather stock than long periods without usage at all.

Experts frequently use kerosene oil to renovate leather. This is a difficult treatment to administer properly and for the average dealer is too likely to result disastrously. For this reason it is here omitted.

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CHAPTER LXXXII.

FOR MATCHING FINISHES.

ONE difficulty in matching is often found in the shellac. The piece you are trying to match may have been coated with orange shellac, whereas, you are using white, or vice versa. Here is a simple test:

FORMULA FOR MATCHING FINISHES.

Coat piece of glass with orange shellac and another with white shellac. Then look through them, say at a piece of fumed oak, and the difference will convince you at once that the shellac coat in finishing plays an important part.

SUBSTANTIAL FILLER FOR OAK.

FORMULA:

Bolted English Whiting	5 pounds
Calcined Plaster	2 pounds
Dry Burnt Sienna	1 ounce
Dry French Yellow	½ ounce
Raw Oil	1 quart
Benzine Spirits	1 pint
White Shellac	½ pint

DIRECTIONS:

Mix well and apply with brush, rub in with excelsior or tow and clean off with rag.

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CHAPTER LXXXIII.

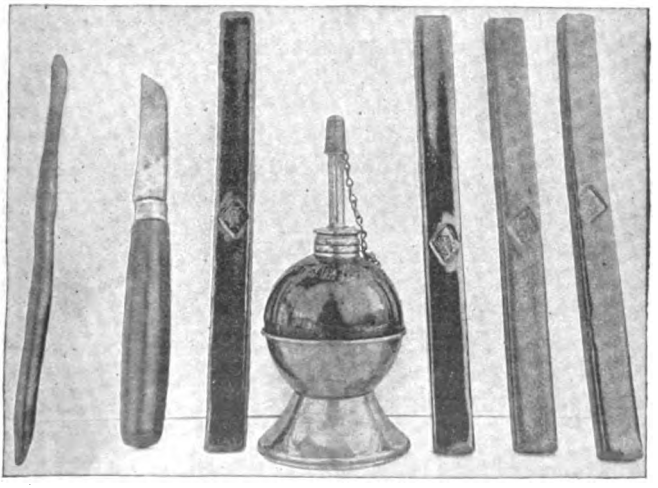
DENTS, DEFECTS AND KNOTS.

THE matter of "lifting" indentations has been touched upon lightly in a previous chapter, but another method will be given here and more in detail.

SERIOUS DENTS CAN BE RAISED.

There is a general impression that a decided dent in a piece of wood or in a piece of finished furniture cannot be corrected. Such is not the truth. Whether the dent be in a solid top or in a piece of veneer need make no difference, it can be effectively removed. Indeed, such dents can be repaired so that even the expert eye cannot detect the location of the dent.

The tools for this work are a knife, spirit lamp, sticks of various shades of wood cement and a stick of gum shellac, shown in the cut herewith. The knife



THE IMPLEMENTS FOR FIXING UP DENTS AND BRUISES

is a thick-bladed shoe knife. The lamp can be bought at any hardware store, but one can be made by cutting off half the length of a machine oil can stem, using the cap of a cartridge to cover the end of the wick when

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not in use. Thus is the evaporation of the alcohol prevented. The cement and the shellac can be purchased readily.

If the dent is in the white wood, wet the dent with water, heat the knife blade, and apply the knife to the dent until the water there evaporates into steam. Repeat until the fibers of the dent are raised up level with or above the surface. After drying for an hour or two, sandpaper and finish as usual. This process can be followed with all woods where the surface is dented or bruised.

WOOD CAN BE REPLACED SUCCESSFULLY WITH CEMENT.

Where a small piece of wood is gone, a knot or bad defect in the wood, this is the method: Stain the defect and all around it in a radius of an inch or more with the same stain that the work is to be finished with. When dry, light the spirit lamp, select cement of the right color or shade, and drop hot particles into the defect. Heat the knife and press down the cement into all the parts. Cut down the cement with a sharp knife or chisel, and sandpaper smooth. The defect must be stained before the cement is put in, as the stain will not hold over the cement, for the cement in the pore of the white wood will show light under the stain.

Veneer blisters can be laid down with the same knife and spirit lamp. After staining veneer work press down the blister with the heated knife, rubbing it close. The work will thus prove better than though the cabinetmaker undertook to raise the blister. Put glue under it, and clamp it down for an hour or two. The hot knife shrinks the blister and warms up the glue underneath, so that a repair is made that cannot be detected; the surface has not been broken, as it would have been had the cabinetmaker cut it open and applied new glue to it.

VENEER BLISTERS REMOVED.

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CHAPTER LXXXIV.

HELP OFFERED IN FIXING FORMULAS.

THE publishers have arranged to supply purchasers of this book with small samples of the anilines employed in the production of the formulas given here.

ANILINES FURNISHED BY PUBLISHERS.

Recognizing the great importance of procuring identical shades and the identical strength of colors in working out formulas, and knowing that there is a possibility of a variance when goods of different manufacture are employed, it was thought that by rendering this service it would enable every one to first establish the correctness of shade and strength of material before attempting to produce results.

The following simple method of procedure will be found most satisfactory:

From the sample take five grains, carefully weighed; then take five grains from the regular stock. Dissolve sample in 10 ounces of water, and the five grains from stock dissolve in five ounces of water. The supposition is that the stock is of the same strength, but that possibly it is not. Place each solution in a bottle of same diameter. If the shade of the stock solution is darker, add water until it is an exact match. Suppose, for example, it requires but eight ounces, then it is stronger than the sample and the same percentage should be figured in making the stain. Eight ounces equaling 10 ounces of the sample indicates that only four-fifths of 80 per cent of the amount given in the formula is to be used. If, on the other hand, the same amount of water were used and the shade is darker, then continue the addition of water until match is complete, either keeping exact count of each quantity of water so added or by measuring entire amount after the match has been attained.

METHOD OF "FIXING" A FORMULA.

Suppose, then, that we added two ounces more, having a duplicate of shade in 15 ounces of water, whereas the original sample was dissolved in 10. It

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means that the stain you have is stronger and your problem is this: In the original you have five grains in 10 ounces of water, or reduced would make it one grain in every two ounces of water. Your stock, however, shows that the same color is produced by using 15 ounces of the water to the five grains, or one grain to every three ounces of water. From which it will be seen at a glance that your stock is one-third stronger than is necessary to attain the color actually sought.

HOW TO BE CERTAIN OF RESULTS.

To be absolutely certain of your results procure white blotting paper, cut it into long, narrow strips and immerse pieces in the two solutions. Let them dry in the air; do not force the drying, also do not remove from the light; normal result is what you are after. If when thus dried the match is satisfactory, you are safe to go ahead. You may find a color that will register darker in solution, but when it has dried down in this manner it will not show this way, and as your work will require the shade when dried, this manner of testing is reliable. When a color shows this peculiarity it is recommended to make the same test on wood.

If you wish a sample aniline to produce any shade or finish mentioned in this book, send 10 cents in silver or stamps, for postage and packing, to the publishers, and it will be sent you gratis.

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